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**TEST PLAN  
FOR THE  
PHYTOREMEDIATION STUDIES  
OF  
LEAD-CONTAMINATED SOIL  
FROM THE  
SUNFLOWER ARMY AMMUNITION PLANT  
Desoto, Kansas**

**Volume I of II**

*Prepared for*  
**U.S. ARMY ENVIRONMENTAL CENTER**  
*Aberdeen Proving Ground, Maryland 21010-5401*

*Prepared by*  
**Tennessee Valley Authority**  
**Environmental Research Center**  
*Muscle Shoals, Alabama 35662-1010*

**October 1996**

**TVA Contract No. RG-99712V**  
**Report No. SFIM-AEC-ET-CR-96198**

***Test Plan***  
**For the Phytoremediation Studies  
of Lead-Contaminated Soils  
from the  
Sunflower Army Ammunition Plant, Desoto, Kansas**

**Volume I of II**

***Prepared for***  
**U.S. Army Environmental Center  
Environmental Technology Division  
Aberdeen Proving Ground, MD 21010-5401  
POC: Ms. Darlene Bader**

**DTIC QUALITY INSPECTED 2**

***Prepared by***  
**Tennessee Valley Authority  
Tennessee Valley Authority Environmental  
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Muscle Shoals, Alabama 35662-1010**

**October 1996**

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## ABBREVIATIONS

AA	-Atomic Absorption
AAP	-Army Ammunition Plant
Cd	-Cadmium
Cr	-Chromium
Cu	-Copper
CDTA	-Cyclohexane - 1,2 - Diaminetetraacetic Acid
CERCLA	-Comprehensive Environmental Response, Compensation, and Liability Act
DANT	-Diaminonitrotoluene
DNT	-Dinitrotoluene
DoD	-Department of Defense
DTPA	-Diethylenetrinitrilopentaacetic acid
EAAL	-Environmental Applications Analytical Laboratory
EDTA	-Ethylenedinitrilotetraacetic acid
EDX	-Energy Dispersive X-Ray
EGTA	-Ethylenebis(oxyethylenetrinitrilo)tetraacetic acid
ERC	-Environmental Research Center
FIA	-Flow Injection Analyzer
Hg	-Mercury
HPLC	-High Performance Liquid Chromatography
IC	-Ion Chromatography
ICP	-Inductively Coupled Plasma
MDL	-Method Detection Limit
NC	-Nitrocellulose
NG	-Nitroglycerin
NH <sub>4</sub> -N	-Ammonia Nitrogen
Ni	-Nickel
NO <sub>3</sub> -N	-Nitrate Nitrogen
NQ	-Nitroguanidine
PEL	-Permissible Exposure Limit
Pb	-Lead
P	-Phosphorus
PO <sub>4</sub>	-Orthophosphate
PO <sub>4</sub> -P	-Orthophosphate - Phosphorus
QA	-Quality Assurance
QC	-Quality Control
Se	-Selenium
SFAAP	-Sunflower Army Ammunition Plant
TKN	-Total Kjeldahl Nitrogen
TOC	-Total Organic Carbon
TVA	-Tennessee Valley Authority
TVAE	-Tennessee Valley Authority Environmental
U.S.	-United States
USACE	-United States Army Corp of Engineers
USAEC	-United States Army Environmental Center
USEPA	-United States Environmental Protection Agency
USIOC	-United States Army Industrial Operations Command
Zn	-Zinc

## SECTION 1.0

### INTRODUCTION

#### 1.1 Background

A number of Department of Defense (DoD) installations have heavy-metal contaminated soils requiring remediation; in part because CERCLA has identified heavy metals, lead (Pb) in particular, as a priority concern. Particulate type heavy metals (bullet fragments, etc.) were often deposited as the result of firing range use. In addition, ionic forms of metals were commonly deposited when metal-bearing propellants, ammunitions, and powders were burned at explosive disposal sites. The DoD is currently emphasizing lead removal due to the inherent toxicity of lead and the quantity discharged. Hence, a need for cost-effective procedures for removing lead from contaminated soils has emerged. This study will examine the removal of ionic lead using phytoremediation (or plant remediation) techniques.

U.S. Army Environmental Center (USAEC) has funded this project as part of a Department of Defense (DoD) program to evaluate treatment technologies. The project's goal is to increase the effectiveness of phytoremediation techniques for extracting ionic lead from contaminated soils. In the phytoremediation technique being examined in this study, selected plant species are used to extract lead and other heavy metals from contaminated soils. The heavy metals are subsequently stored in the plant's shoot tissues. After the plants die, the shoots are harvested and can be either processed for metals recovery or disposed of as a hazardous waste.

The purpose of this project is to find ways to increase the uptake of lead by plants and enhance the movement of lead to the shoot tissues for later harvest and disposal. One barrier to this process is that lead is insoluble in soil solution, thus its availability to plants is generally low. In this project, lead solubility will be increased through the use of chelates coupled with adjustments to soil pH. The technique is expected to work due to the behavior of the chelates. Simplistically, a chelation may be viewed as the multiple bonding of a metal to co-ordinating groups (or ligands) of an organic compound to form a ring structure. The water solubility of the metal ions is increased by the ligands with which it becomes co-ordinated.

An additional barrier to phytoremediation use is lead's tendency to accumulate within the root structures of most plants rather than moving to the aerial shoots. The presence of chelates in soil has been shown to enhance the translocation of lead to the shoots in selected plant species, allowing accumulation of up to 2% lead in the aerial portion. Hence, it may be possible to improve the efficiency of phytoremediation techniques. The impact of chelate use, soil pH adjustment, and the use of selected plant species on the efficiency of current phytoremediation techniques will be the focal point of this project.

This project is being executed under a partnering agreement between the:

- U.S. Army Environmental Center
- Tennessee Valley Authority Environmental (TVAE)

The USAEC, the U.S. Army Corp of Engineers (USACE) Kansas City District, and the U.S. Army Industrial Operations Command (USIOC) are providing contaminated soil from the Sunflower Army Ammunition Plant at Desoto, Kansas. TVAEC is providing technical expertise in plant lead uptake, application of soil amendments, and metals analysis for soil and plant samples. This document is intended to serve as the project's test plan.

## **1.2 Current Practices and Alternatives**

Several procedures for remediating metals-contaminated soils are currently available. These include:

- Landfilling of contaminated soil.
- Soil washing (separation) - excavation of soil followed by soil washing, return of clean soil to the site, and landfilling of contaminated soil.
- In-situ soil flushing - in place washing of soil using acid or chelate solutions followed by pumping of contaminated leachate to the surface for treatment.

- Containment - placing a cap on the contaminated site to eliminate water infiltration of the contaminated soil.
- Phytoremediation - plant species are used to extract heavy metals from the soil and are then harvested.

These technologies, except containment, provide a clean site and normally avoid restrictions to site use; however, they are also costly (Table 1-1). Currently the lowest cost option is phytoremediation.

### **1.3 Project Objectives**

The primary objective of this project is to determine whether enhancing the water solubility of soil-borne lead will be a practical and affordable method for improving the phytoremediation of lead-contaminated soils. Lead solubility will be increased through the use of a chelating agent and adjustment of soil pH. Specific objectives are to:

- Select the chelate, chelate concentration, and soil pH level that provide the optimum solubilization of lead in the soil for plant uptake.
- Determine the optimum method for applying the chelate.
- Monitor the movement and degradation of chelate in the soil over time.
- Select the combination of plant species, soil amendment concentrations (chelate and soil acidifier), and foliar phosphate fertilization that optimizes lead uptake and results in translocation to the shoot.
- Determine the effectiveness of the selected soil amendment levels, application method, plant species, and fertilization levels under simulated field conditions.
- Determine the extent, if any, to which lead will leach out of the root zone when soil amendments are applied under simulated field conditions.

**Table 1-1**  
**Comparison of Remediation Costs**

<b>Remediation Method</b>	<b>Cost of Remediation Technique (\$ per cubic yard)</b>
Phytoremediation	\$25 - \$124 <sup>2,3</sup>
Containment	\$100 - \$175 <sup>4</sup>
Landfilling	\$165 - \$410 <sup>2,3</sup>
Soil washing	\$175 - \$390 <sup>5</sup>
In-situ soil flushing	\$300 - \$380 <sup>5</sup>

#### 1.4 Approach

The project is being executed in five phases, these being:

- Test Plan Development (Phase 1). During this phase the project will be planned and developed.
- Site Screening, Soil Collection, and Metal Analysis (Phase 2). During this phase contaminated soil at various sites will be considered for use, selected, collected and analyzed for pH and heavy metals content.
- Preliminary Laboratory Studies (Phase 3). This phase consists of two studies: one for chelate screening (the Chelate Screening Study) and another addressing chelate application (the Chelate Applications Study). The purpose of these studies will be to assess the variables affecting lead solubilization (i.e. chelate type, concentration, soil pH, and methods of soil application) and monitoring of the movement and fate of soil amendments.
- Greenhouse Studies (Phase 4). This phase consists of three greenhouse studies: one pot study for screening plant species (the Plant Screening Study); a second pot study addressing the foliar application of phosphate nutrients (the Foliar Application Study); and a third study in which the most effective plant species, soil amendment treatments, and fertilizer levels from two previous greenhouse studies will be used in larger volumes of soil to more closely simulate soil leaching in field conditions (the Soil Leaching Study). The Soil Leaching Study will also include an after-harvest replanting to determine the effect of lead and residual chelate on seed germination and plant growth, leaching of lead by residual chelate, and lead removal by subsequent planting.
- Final Report Writing (Phase 5). During this phase the final report will be written.

The project will begin in the fall of 1996 with test plant development (Phase 1), and the screening of contaminated sites, and transport of selected soil to the TVAE facilities (Phase 2). The lead-contaminated soils will be collected from an explosives burning ground located at the

Sunflower Army Ammunition Plant (SFAAP) in Desoto, Kansas, and brought to the TVAE's facility in Muscle Shoals, Alabama where the lead uptake project will be performed.

Once the soil is available, a preliminary assessment will be initiated (Phase 3) to determine the soil amendments required, methods of amendment application, and fate of amendments applied. Concurrent with the preliminary assessment, plants will be grown for use in the Plant Screening Study (Phase 4). The selected soil amendments will not be applied until plants reach full vegetative biomass (i.e. growth of plants up to onset of flowering) and the results of the preliminary studies are available.

During the Plant Screening and Foliar Application Studies (Phase 4), soil amendments will be applied to the potted plants to facilitate lead uptake. The plants are expected to senesce and die within two weeks due to uptake of large amounts of lead into their tissues, at which time they will be harvested. The plant shoots and soil will be analyzed for lead concentration. Dry matter content of plants will also be determined.

After the Foliar Application Study, the Soil Leaching Study will be initiated. During the soil leaching study, columns containing approximately 25 kg of soil will be planted with the best warm and cold weather species from the previous study. The plants will be grown to full vegetative biomass - again before the addition of soil amendments. Leachate collected from the containers will be analyzed for heavy metals content. Prior to adding soil amendments the leachate will be collected every two weeks. After amendments are added, the leachate will be collected daily until plant harvest. In addition, the soil will be analyzed for lead and other heavy metals. The heavy metals content of the plant shoots will be analyzed after harvest. After the initial harvest, the containers will be replanted. The plants will again be grown to full vegetative biomass, harvested, and analyzed for lead and heavy metals content. After harvest, soil will be analyzed for lead, heavy metals, and chelate content. Leachate will be collected once a week during this phase of the program.

During the final phase of the project, Phase 5, the final report will be written.

## 1.5 Schedule

A GANTT chart of project-related activities is provided in Figure 1-1. As indicated in the section above, there are five phases to this study. The timelines for these phases are:

- Test Plan Development (Phase 1). Begins on September 6, 1996, and is scheduled to end on December 8, 1996.
- Site Screening, Soil Collection, and Metals Analysis (Phase 2). Begins on August 6, 1996, and is scheduled to end on December 9, 1996;
- Preliminary Laboratory Studies (Phase 3). Begins on December 9, 1996, and is scheduled to end on March 8, 1997. Studies to be conducted within this phase have timelines as follow:
  - ⇒ Chelate Screening Study - December 9, 1996, to December 23, 1996.
  - ⇒ Chelate Applications Study - December 16, 1996, to March 8, 1997.
- Greenhouse Studies (Phase 4). Begins on November 29, 1996, and is scheduled to end on January 7, 1998. Studies to be conducted within this phase have timelines as follow:
  - ⇒ Plant Screening Study - November 29, 1996, to April 28, 1997.
  - ⇒ Foliar Application Study - March 18, 1997, to August 5, 1997.
  - ⇒ Soil Leaching Study - May 19, 1997, to January 7, 1998.
- Final Report Writing Phase (Phase 5). Begins on January 7, 1998, and is scheduled to end on April 1, 1998.

The start dates listed above are dependent upon the timely arrival of soil at the ERC facilities.

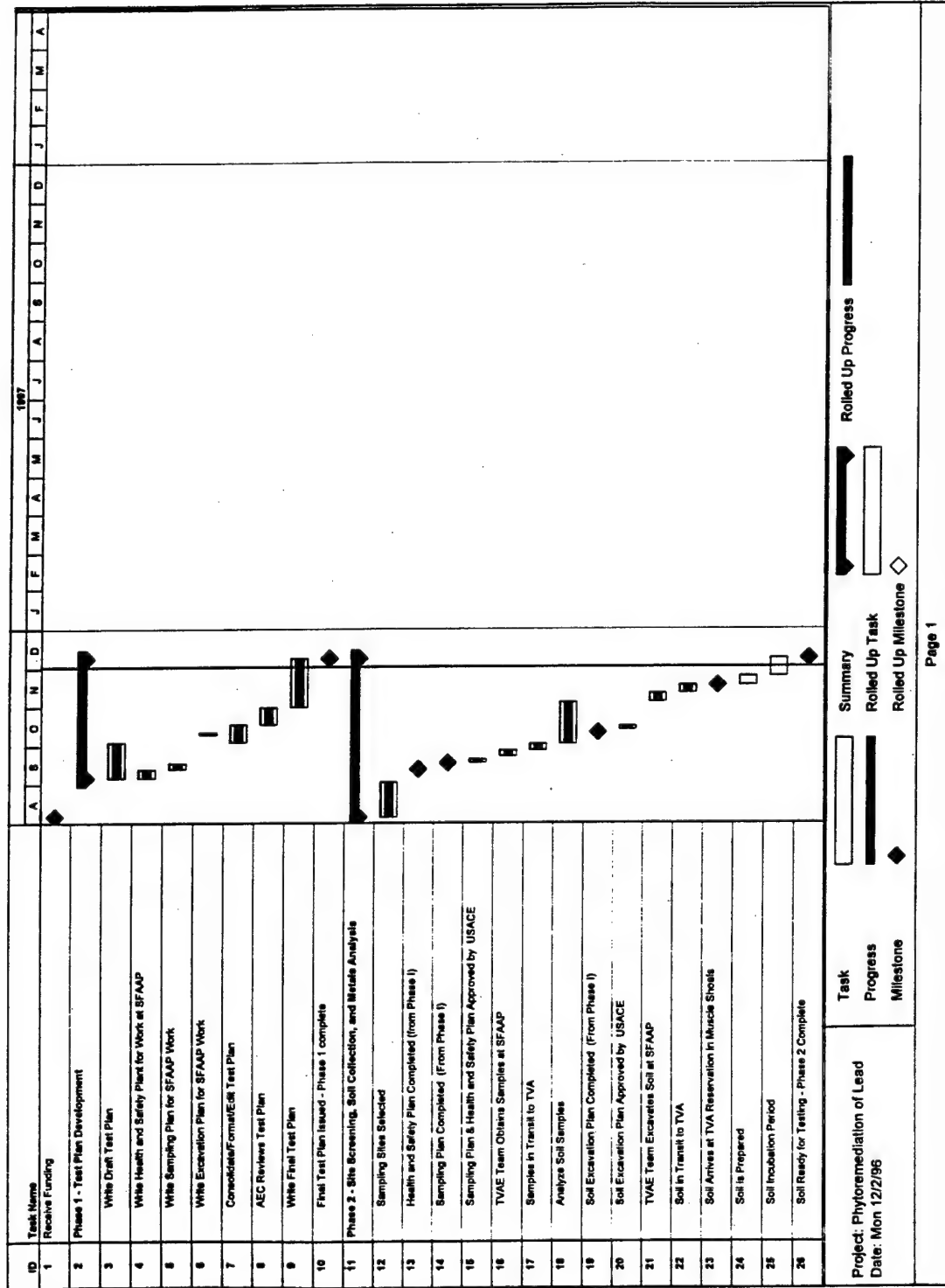
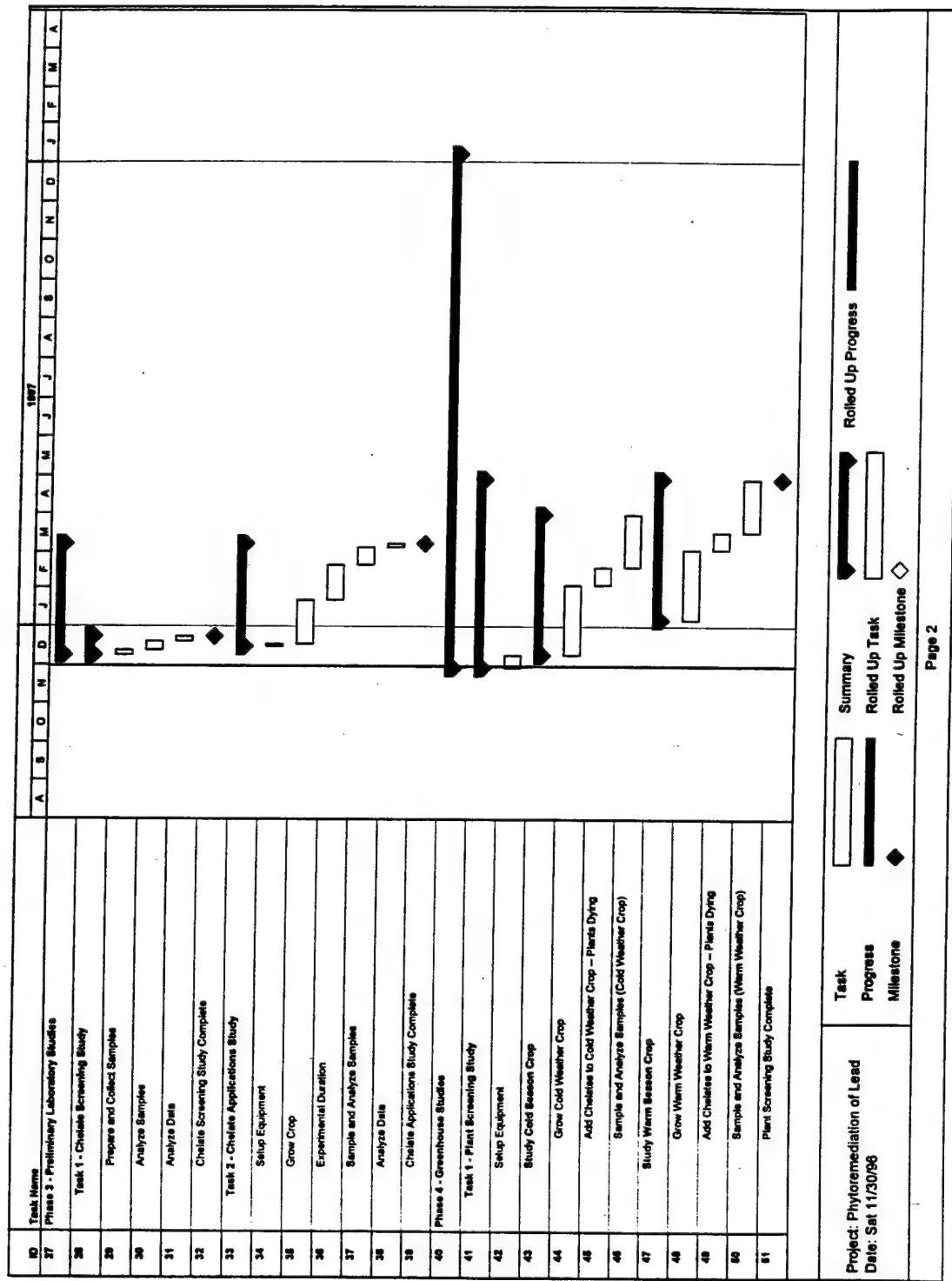
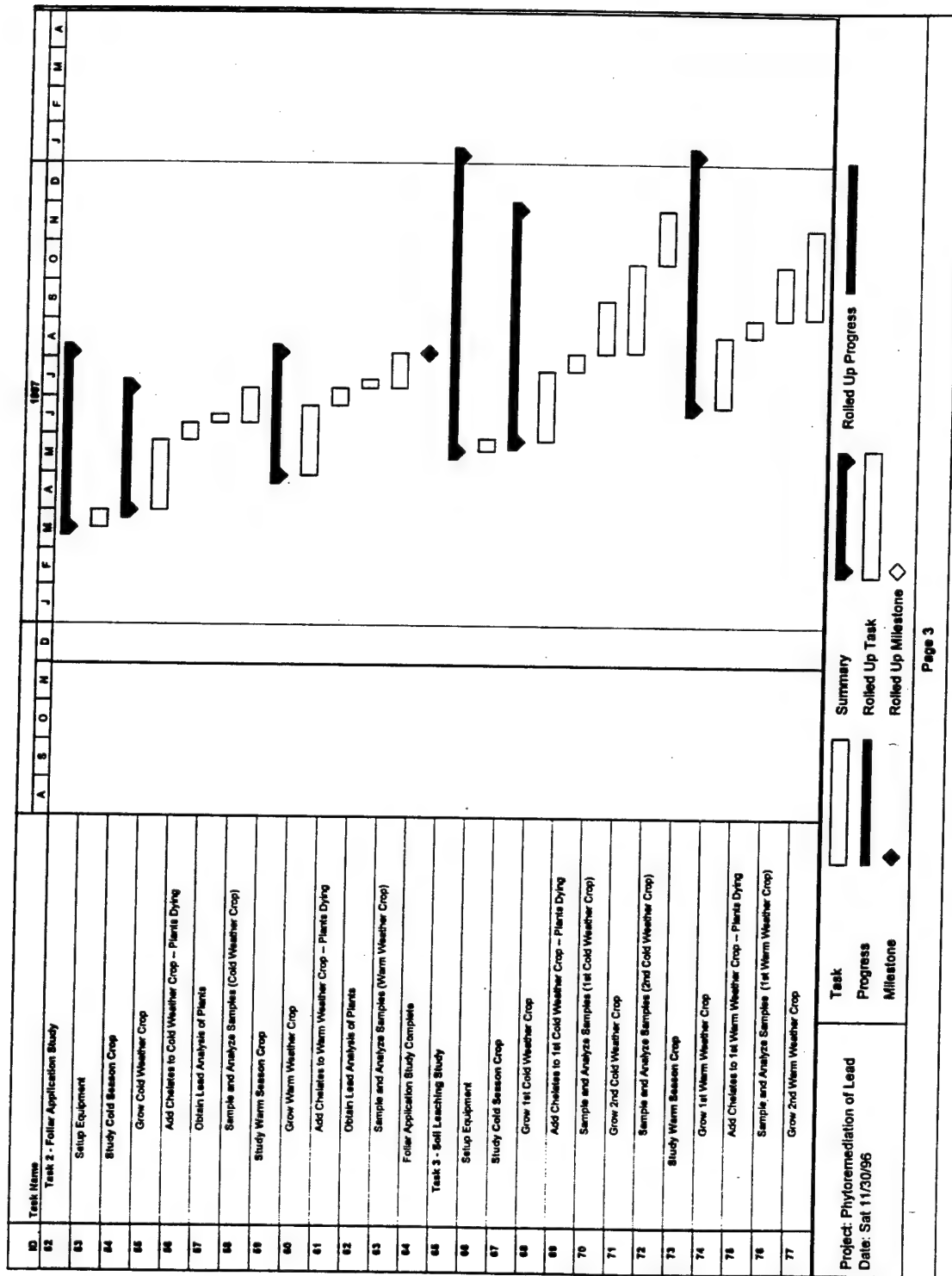


Figure 1-1  
GANTT Chart for Lead Uptake Project



**Figure 1-1 (Continued)**  
**GANTT Chart for Lead Uptake Project**



Page 3

Figure 1-1 (Continued)  
GANTT Chart for Lead Uptake Project

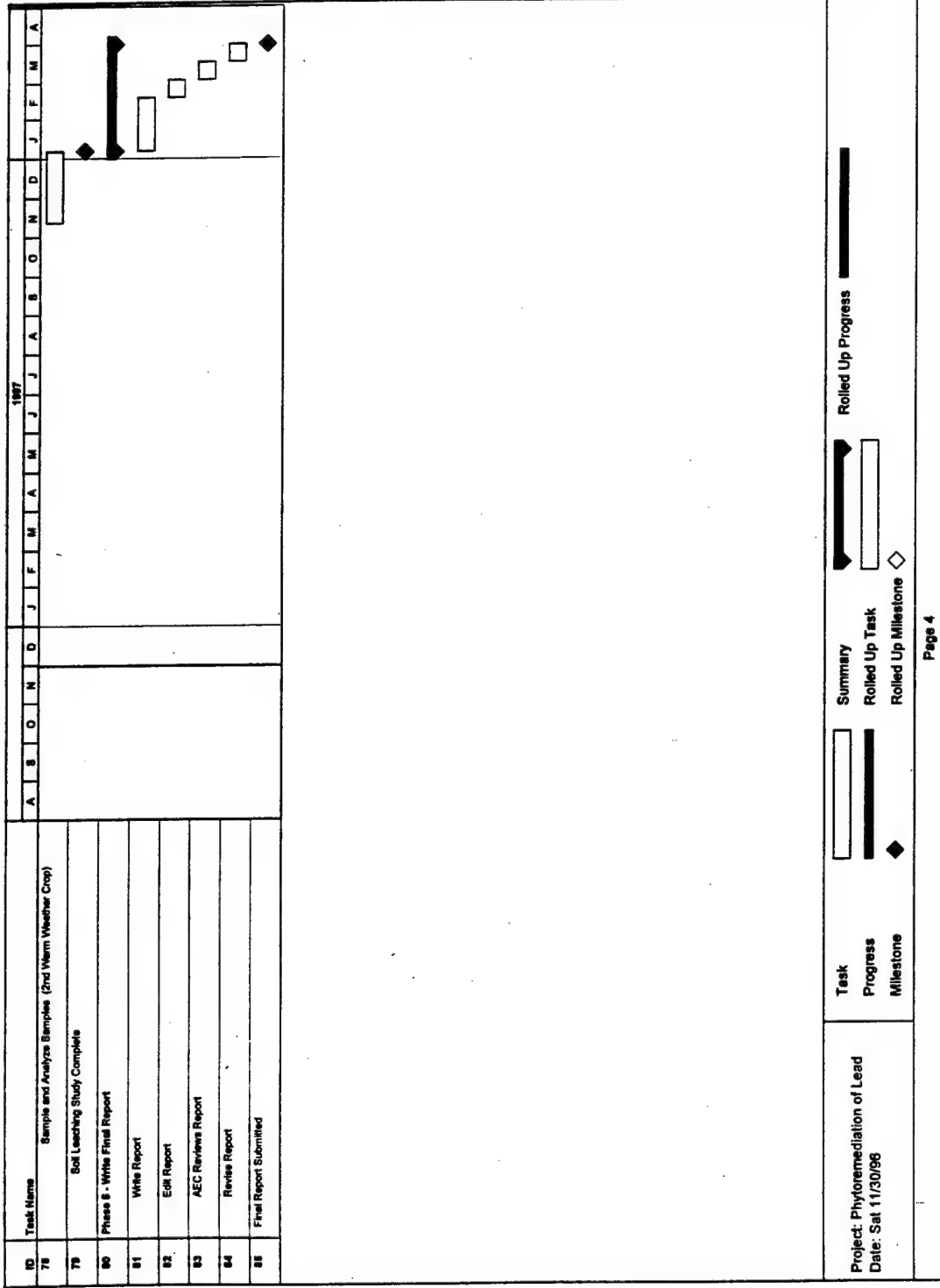


Figure 1-1 (Continued)  
GANTT Chart for Lead Uptake Project

## SECTION 2.0

### LOCATION AND HISTORY

#### 2.1 General Background

In consultation with the USAEC and the USACE, it was decided to obtain lead-contaminated soil from an explosives burning ground located at the Sunflower Army Ammunition Plant in Desoto, Kansas. Site selection was based on three major criteria:

- Lead-contamination at the site was ionic in nature and therefore amenable to the use of phytoremediation techniques.
- The depth of contamination was less than one foot and therefore accessible to the root structures of most plants.
- The area showed textural differences in the soil. Testing with two or more soil textures was considered desirable for the purposes of demonstrating the technology.

The Sunflower AAP is located approximately 30 miles southwest of Kansas City, Kansas, and 16 miles east of Lawrence, Kansas, along Route 10. The SFAAP encompasses about 10,000 acres and is located south of DeSoto, Kansas in the northwest corner of Johnson County (Figure 2-1). The area immediately surrounding SFAAP is a sparsely populated area composed of privately owned agricultural lands. The plant is bounded on the east by the Spoon and Kill Creeks, and on the west by Captains Creek. The Kansas River is located approximately three miles north of the plant.

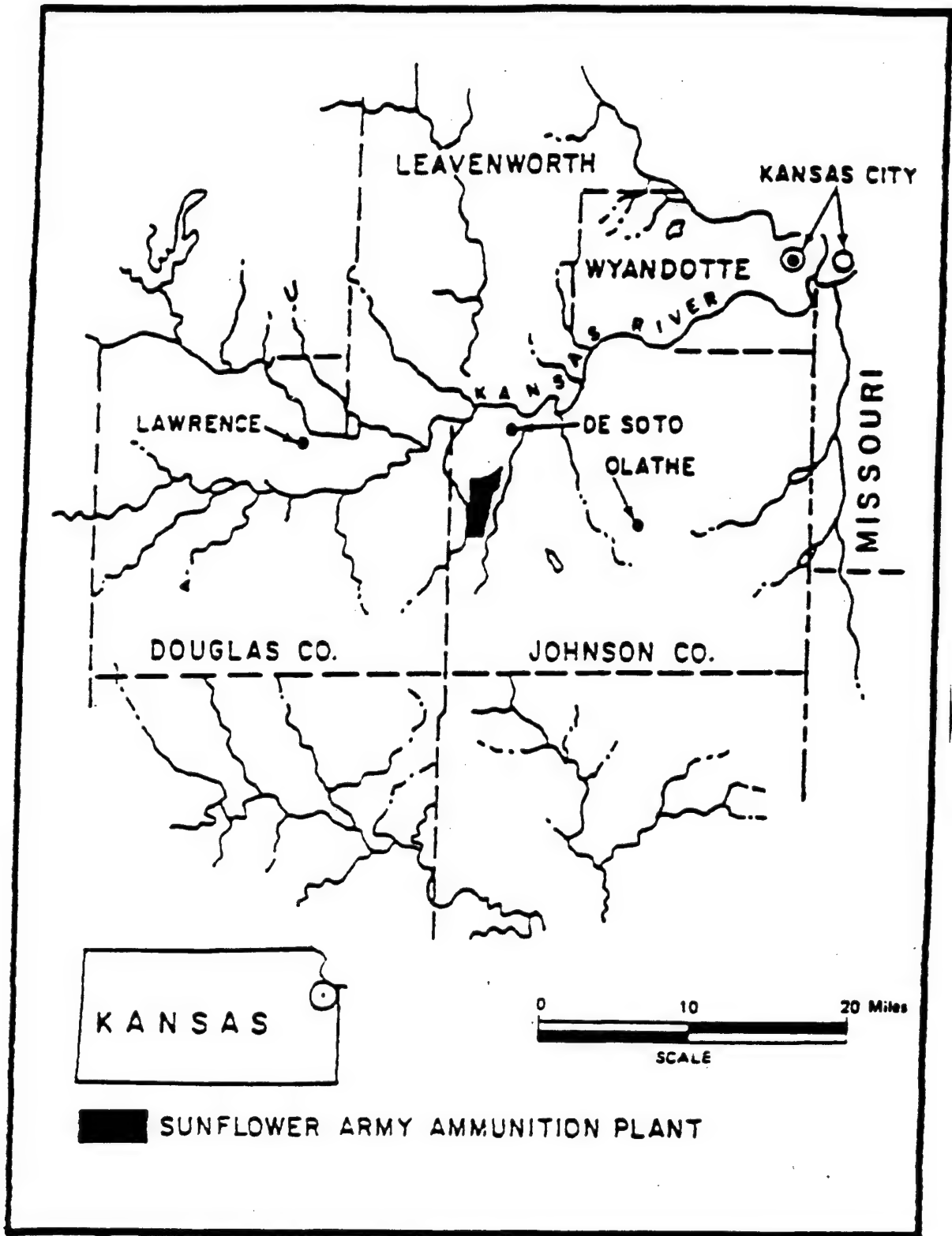


Figure 2-1

Location of the Sunflower Army Ammunition Plant

## **2.2 History of the Sunflower Army Ammunition Plant**

The Sunflower AAP is a government-owned contractor-operated facility which has intermittently manufactured smokeless powder, propellants, and related products since the early 1940s. The production history of the plant is summarized in Table 2-1.

SFAAP began production of propellants and related products in 1943. Over the years, three base explosives have been produced for incorporation into the propellants: nitroglycerin (NG), nitrocellulose (NC), and nitroguanidine (NQ). The propellants manufactured at SFAAP consisted of one or more of the three base explosives, a stabilizer, a plasticizer, extrusion lubricant, and generally two burning rate modifiers. In addition to the base explosives, nitric and sulfuric acids were manufactured at the plant. These acids are required to produce the organic nitrates and calcium cyanamide, the major raw material used in the NQ production process. The NG, NC, and acid production areas have long been operated at SFAAP, whereas NQ and calcium cyanamide production did not begin until the late 1970s. Processes involved in the production of propellants included mixing, washing, air drying, blending, rolling, pressing, annealing, fluoroscoping, milling, and trimming. Support functions for the production processes included product testing and storage, water and steam production, waste treatment, and facility maintenance.

Recent activities at SFAAP have occurred at the acid area facilities, continuous paste facility, mechanized roll (solventless roll) complexes, and the NG facility. The NQ facility was shut down on September 1, 1992, and has been put into "stand-by" status.

## **2.3 Description of the Lead-Contaminated Site at SFAAP**

The soil sampling and excavation of lead-contaminated soil will be conducted on an explosives burning ground located within the SFAAP. The explosives burning ground consists of five approximately 1 acre "cells" plus additional outlying areas of approximately 7-10 acres. Lead contamination in the burning grounds originated from the burning of N-5 propellant, a mixture of organic and lead-organic compounds. N-5 rocket propellant was produced at SFAAP from 1943 to 1971. The range of lead contamination over the burning area is 10-15,800 mg/kg. Other heavy metals are also present in varying concentrations.

**Table 2-1**  
**Production History of the Sunflower AAP**

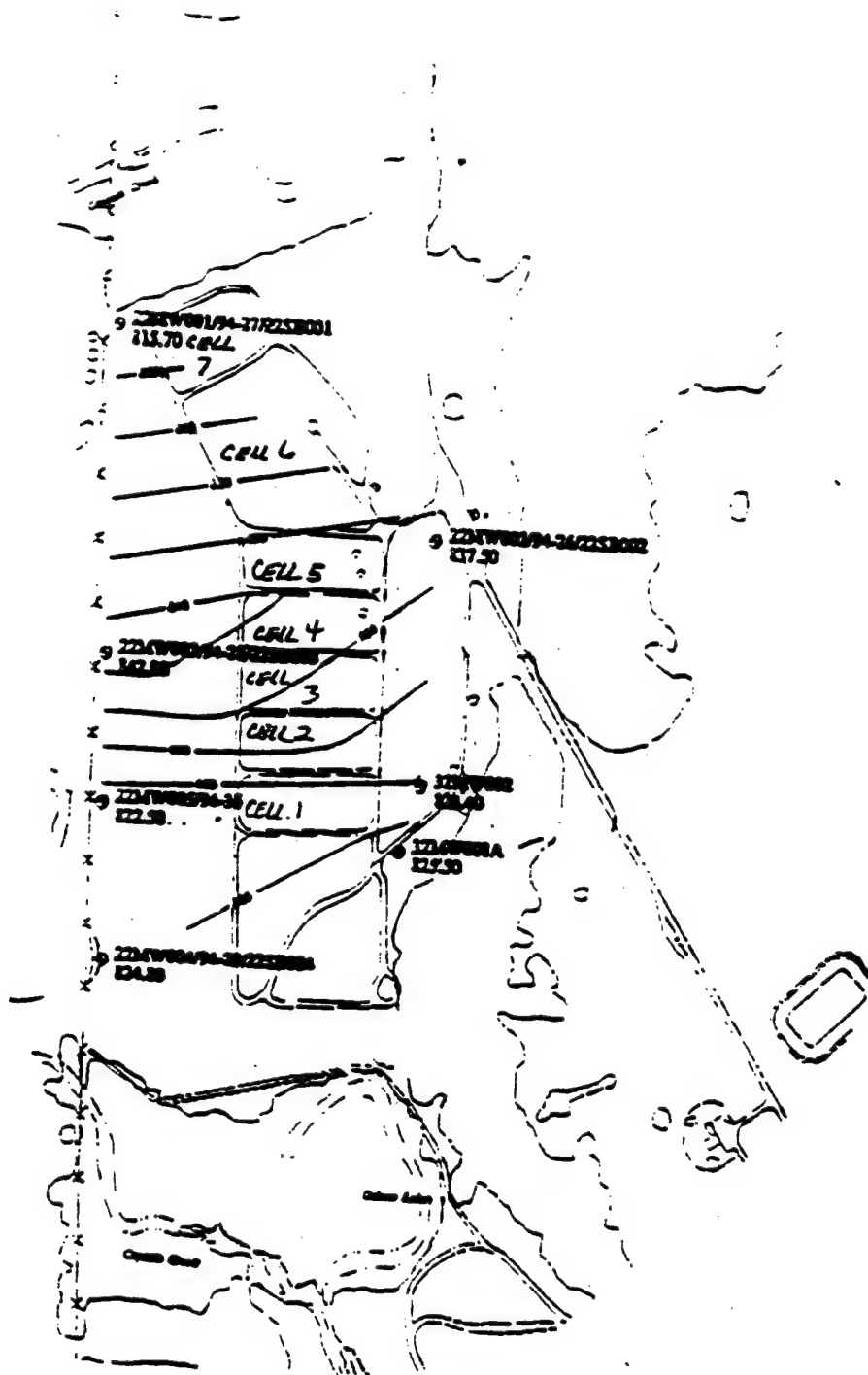
Year	Event
1942	Construction began.
1943	Production began.
1943-1948	Propellant produced.
1948-1951	Standby maintenance; ammonium nitrate liquor and NC production continued while majority of plant was inactive.
1951-1960	Propellant produced.
1960-1965	Standby maintenance; sulfuric acid production continued while majority of plant was inactive.
1966-1971	Propellant produced.
1971-1977	Standby maintenance.
1977-1992	NQ and calcium cyanamide produced.
1992-present	NQ facility in standby mode.

Two sites will be selected for soil sampling, one site will be located in Cell 1 and the other in the northern-most outlying area. The northern most area has been designated as Cell 7 for the purpose of this plan (Figure 2-2). Cell 7 is within 850 feet of the northern-most arm of a flowing creek (Captain Creek), while Cell 1 is approximately 1500 feet distant to the south. Both cells are located on a sloping, grassy meadow.

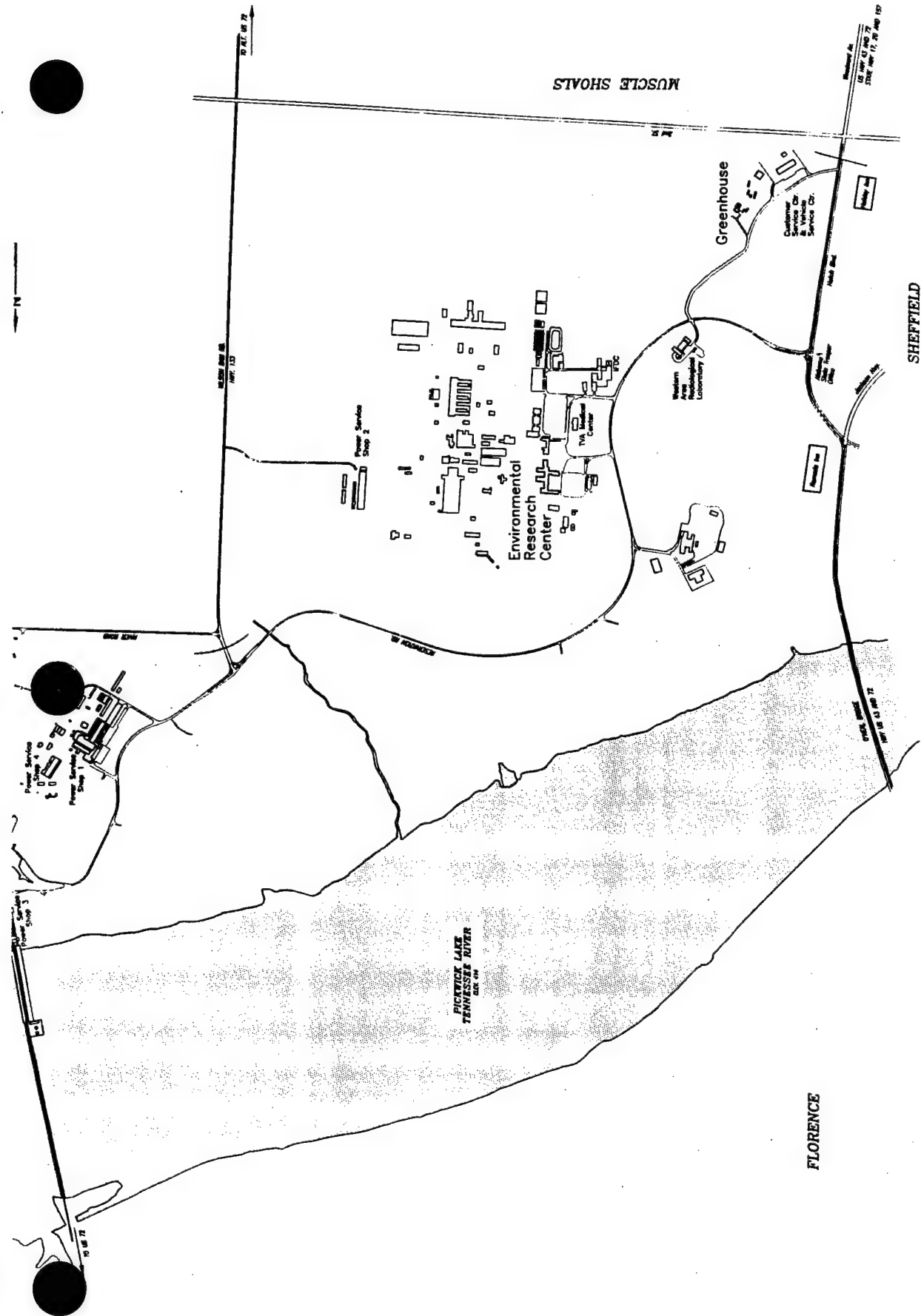
The soil is generally classified as Kennebec alluvial silt loam, although there are distinct textural differences ranging from the silt loam to a silty clay. Soil core samples will be taken from Cells 1 and 7. Previous physical analyses shows the soil in Cell 1 to be an alluvial silty clay (50% silt, 50% clay), and the soil in Cell 7 to be an alluvial silt loam (60% silt, 25% sand, and 15% clay). (Data obtained by correspondence with USACE) There is sufficient distance between cells that there is a distinct difference in textural classification in the soil, and thus for the purpose of this project, the soil may be considered as being of two distinct types.

#### **2.4 Location of TVAE Facilities**

The lead uptake study will be conducted at the TVAE's Environmental Research Center located within the TVA Reservation near Muscle Shoals, Alabama. The TVA Reservation is located in the northwest corner of Alabama just north of the city of Muscle Shoals, in Colbert County, along the banks of the Tennessee River just southwest of Wilson Dam (Figure 2-3). The city of Muscle Shoals is located approximately 65 miles west of Huntsville, AL; 115 miles south of Nashville, TN; 110 miles north of Birmingham, and 150 miles southeast of Memphis, TN.



**Figure 2-2**  
**Location of Cells 1 and 7 at the SFAAP**



**Figure 2-3**  
**Location of TVA's Environmental Research Center**

## SECTION 3.0

### TECHNOLOGY DESCRIPTION

Phytoremediation is an alternative method for restoring soils contaminated with lead and other heavy metals. With phytoremediation, plant species are utilized that accumulate high concentrations of metals in their tissues in order to extract the metals from the soil. Chelates and soil acidifiers are added to the soil to make the metals more soluble and thus more readily taken up by the plants and translocated to the shoots, especially in the case of lead, which is the least soluble and least mobile of the heavy metals in the soil. The advantages of phytoremediation relative to current remediation methods are:

- Heavy metal removal by plant harvesting minimizes site disturbance, limits the dispersal of contaminants, and may allow for unrestricted site use after remediation is complete.
- Heavy metals recycling is possible via the processing of the harvested plant tissues.
- The amount of hazardous waste produced is reduced.
- The costs and long-term liability associated with maintaining a landfilled hazardous waste is substantially reduced or eliminated.
- Low costs are incurred. Phytoremediation costs range between \$25 to \$124 per cubic yard.

However, there are concerns about the use of phytoremediation. One concern involves the use of soil amendments to increase the solubility, and hence mobility of heavy metals in the soil. The increased mobility increases the possibility of leaching lead out of the plant root zone into lower layers, adjoining areas, or groundwater when applied in the field.

In addition, plants used to remediate soil containing lead at concentrations greater than 3000 to 4000 g lead per kg soil, while not exhibiting lead toxicity effects due to the insoluble nature of lead in soil, would require a number of years to remove such a high concentration of lead from the soil (S. Cunningham, personal communication). Plants grown in soils with these levels of

lead contamination may also exhibit phosphorus deficiency, with a concomitant decrease in plant growth and biomass accumulation, which in turn decreases remediation effectiveness by reducing total lead uptake (Huang and Cunningham, 1995). However, soil-applied phosphate fertilizer binds lead as insoluble  $Pb-PO_4$  complexes, decreasing the availability of lead for plant uptake. These concerns and others will be addressed during this project.

Several studies have evaluated the use of plant species and soil amendment for efficiency in lead uptake and translocation to the shoot. These studies indicate:

- Cultivars of the species Indian mustard (*Brassica juncea* (L.) Czern.) and several other *Brassica* species were able to accumulate from 0.7 to 3.5% lead per dry shoot weight from hydroponic solutions and sand/perlite mixtures<sup>2</sup>.
- Corn exposed to low lead concentrations (4 ppm) in hydroponic solutions accumulated 0.2% lead in shoots<sup>3</sup>.
- In pot studies, shoot lead concentrations have reached 1% lead in corn (*Zea mays* L.) and peas (*Pisum sativum*) when potted soil was treated with chelates<sup>5</sup>.

Phytoremediation is also being assessed on a number of field sites contaminated with lead and other heavy metals. These include:

- Bayonne, NJ: a site owned by Texaco contaminated with 1000 parts per million (ppm) lead is being remediated using the plant species Indian mustard, with soil amendments of the chelate EDTA alone and EDTA in combination with acetic acid to lower soil pH. Lead concentrations in plant shoots have attained 0.4%. Remediation is estimated to require two to three years<sup>6</sup>. Five additional sites contaminated with lead and other heavy metals are also being treated with phytoremediation techniques (M. Blaylock, personal communication).
- Palmerton, PA: a Superfund site contaminated with 2,000 to 50,000 ppm zinc and 38 to 1,020 ppm cadmium is being used to assess the effectiveness of the species Alpine pennycress (*Thlaspi caerulescens*) in removing soil contaminants in conjunction with soil

amendments to acidify the soil<sup>7</sup>. Zinc concentrations in Alpine pennycress shoots from the field site were 0.6 to 1.0% (R. Chaney, personal communication). In greenhouse studies using soil from the Palmerton site, Alpine pennycress accumulated 1.8% Zn and 0.1% Cd in the shoots without yield reduction associated with metals toxicity<sup>8</sup>.

- Liberty Park, NJ site: soil contaminated with chromium is being remediated by planting with Indian mustard<sup>9</sup>.

## SECTION 4.0

### EXPERIMENTAL DESIGN

#### 4.1 Introduction

This project will examine the validity of chelate use in phytoremediation through laboratory and greenhouse studies. Two preliminary laboratory studies will evaluate overall chelate effectiveness and persistence in soil. Three greenhouse studies will test six plant species for their effectiveness in removing lead from two contaminated soils which differ in chemical and physical properties.

#### 4.2 Approach

The principles of chelation chemistry will be used as the basis for this project. In this work, a chelating agent will be used in conjunction with adjustments to soil pH to increase the amount of lead in the soil solution which will be available to the plant. The concentration of chelate will be controlled to create a balance between the amount of solubilized lead and the maximum capacity of the plant to uptake lead. This is intended to minimize possible lead leaching. Calculations based on competitive metal-chelate equilibria will be used to determine the theoretical maximum amount of chelate required for each plant species. It is recognized that this approach is only an approximation, since these calculations are based on pure systems which contain no other competing ligands that might complex with lead and no other metals that would complex with the ligand.

Ideally the amount of chelate to use would be that which complexes with only the amount of lead the plant can assimilate. To avoid using excess chelate, a range of concentrations to be added to each soil will be calculated to encompass 0, 33, 66, and 100% of the theoretical maximum. This approach is intended to minimize both chelate costs and the risk for metal leaching.

### **4.3 Soil Characterization, Collection, and Processing**

Prior to beginning any studies, TVAE will select two sites at SFAAP which are likely to contain a suitably contaminated soil with which to conduct this project. The soil from these two sites will then be collected and analyzed for the purpose of mapping (characterizing) the degree of lead contamination in immediate area. The soil will later be excavated and shipped to TVAE's Environmental Research Center (ERC) in Muscle Shoals, AL for use during this project.

During the soil characterization phase, each site shall be subdivided into 36 fifteen-foot grids and then sampled using a hand-held soil probe. A total of 144 soil samples will be taken (36 grids/site X 2 sample depths/core X 2 sites = 144 soil samples) and shipped to the ERC for analysis. The samples will be analyzed for pH and total lead (Table 4-1).

After the sampling sites have been properly mapped, TVAE will return to SFAAP and obtain bulk quantities of the soil (1,000 kg per site) and ship it to the ERC in Muscle Shoals, AL. Once the soil arrives in Muscle Shoals it will be processed by passing the soil through a gasoline powered soil shredder/screen. The soil will then be thoroughly mixed to homogenize it. Finally, twelve soil samples will be taken from the soil mixture and the soil will be rebarreled and stored. The soil samples obtained during this process will be used to determine the chemical characteristics and nutrient content of the soil (Table 4-2). This data will be used to establish a baseline for use in the studies to follow and as a screening for subsequent analysis of eight metals (Pb, Cd, Cu, Ni, Zn, Cr, Hg, and Se). Metals not detected above the permissible exposure limit (PEL) during the bulk sampling phase will not be sought in the studies to follow.

**Table 4-1**

**Chemical Analyses for the Soil Characterization / Mapping Work**

<b>Sample Type</b>	<b>Minimum Sample Size <sup>1</sup></b>	<b>Parameter Measured</b>
Soil	12 grams	pH Total Metals (Pb) <sup>2</sup>

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.
- (2) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.

**Table 4-2**  
**Chemical Analyses for Bulk Soil Sampling**

Sample Type	Minimum Sample Size <sup>1</sup>	Parameter Measured
Soil	60 grams	pH Total Organic Carbon (TOC) Total Kjeldahl Nitrogen (TKN) Exchangeable P Exchangeable K Exchangeable Ca Exchangeable Mg Exchangeable Al DTPA-extractable Fe DTPA-extractable Mn Total Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>2</sup> Total Metals (Hg) <sup>2</sup> Total Metals (Se) <sup>2</sup> Plant-available Pb

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.
- (2) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.

#### **4.4 Description of Preliminary Laboratory Studies**

##### **4.4.1 Chelate Screening Study**

The Chelate Screening Study will evaluate the efficiency of different chelates in solubilizing soil metals at various concentrations and at different soil pH levels. Naturally, chelate selectivity for lead will be of particular interest. An overview of the experimental design for the Chelate Screening Study is provided in Table 4-3, and details of the experimental design are provided in Table 4-4. A listing of the chemical analyses to be performed are provided in Table 4-5.

It is well documented that various elements in soil can alter a chelate's ability to complex a metal due to competing ion effects. Lowering soil pH will, in most cases, increase the amount of metal in the soil solution as well. This occurs because protons (hydrogen ions) compete with the metals for exchange sites on clay micelles and organic components in the soil. Metals unable to secure an exchange site become available for complexing by the chelate to a soluble form available for plant uptake. This study will be conducted at the indigenous soil pH and at a pH of 5.5 where lead is at an optimum solubility. Treatments will be applied to soil samples of 100 grams in weight. Three chelates have been selected for study:

- Ethylenedinitrilotetraacetic acid (EDTA)
- Cyclohexane - 1,2 - Diaminetetraacetic Acid (CDTA)
- Ethylenebis(oxyethylenetrinitrilo)tetraacetic acid (EGTA)

The chelate most effective at promoting lead solubility in the Chelate Screening Study will be used in Chelate Applications Study and subsequent greenhouse studies.

**Table 4-3**

**An Overview of Experimental Designs for the Preliminary Laboratory Studies**

Chelate Screening Study

3 Chelates

3 Chelate concentrations

2 soil pH levels

2 soils

plus

2 controls

20 treatments replicated 3 times for each soil

**Total: 120 units, 120 samples**

Chelate Applications Study

1 cropping system (planted)

1 chelate level

2 volumes of water for chelate application

3 time periods

2 soils

2 replicates

5 depths

**Total: 24 units, 120 samples**

Table 4-4

## Experimental Design Details for the Chelate Screening Study

Soil Source	Chelate Type	pH	Number of Chelate Concentrations	Number of Replicates	Chemical Analyses	Number of Soil Samples
Cell 1	EDTA	Natural	33, 66, & 100 % of max.	3	See Table 4-5	9
"	EDTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	EGTA	Natural	33, 66, & 100 % of max.	3	"	9
"	EGTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	CDTA	Natural	33, 66, & 100 % of max.	3	"	9
"	CDTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	Control	Natural	0 % of max.	3	"	3
Cell 1	Control	pH 5.5	0 % of max.	3	See Table 4-5	3
Total						60
Cell 7	EDTA	Natural	33, 66, & 100 % of max.	3	See Table 4-5	9
"	EDTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	EGTA	Natural	33, 66, & 100 % of max.	3	"	9
"	EGTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	CDTA	Natural	33, 66, & 100 % of max.	3	"	9
"	CDTA	pH 5.5	33, 66, & 100 % of max.	3	"	9
"	Control	Natural	0 % of max.	3	"	3
Cell 7	Control	pH 5.5	0 % of max.	3	See Table 4-5	3
Total						60
Grand Total						120

**Table 4-5**  
**Chemical Analyses for the Chelate Screening Study**

Sample Type	Minimum Sample Size <sup>1</sup>	Preservative Added	Parameter Measured
Soil	10 grams	None	pH
Water Extract	50 ml	Filtered <sup>2</sup> then Nitric Acid added (until pH<2)	Total Dissolved Metals (Pb, Cd, Cu, Ni, Zn, Cr) Total Dissolved Metals (Se) Total Dissolved Metals (Hg)

(1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.

(2) Filtered through Whatman #2 or equivalent.

#### **4.4.2 Chelate Applications Study**

The persistence of chelate in soil may have implications for lead leaching after a crop is removed. This study will determine how best to introduce the chelate into the soil and will test the degradation rate of the chelate once it is in soil.

The study will be conducted in planted soil columns (2 inches in diameter and 24 inches in length and containing approximately 1.6 kg of soil) to determine if root exudates affect the structural integrity of the chelate. Soil will be sampled after three different equilibration periods and at five depths (0-3, 3-6, 6-12, 12-18, and 18-24 inches) to determine chelate persistence and movement in soil. An overview of this study's experimental design is provided in Table 4-3, and details of the experimental design are provided in Table 4-6. A listing of the chemical analyses to be performed is provided in Table 4-7.

#### **4.5 Greenhouse Studies**

The greenhouse studies will consist of:

- 1) A Plant Screening Study to determine the most efficient warm and cool season plants and the optimal chelate concentration and soil pH for greatest lead removal from each soil;
- 2) A Foliar Application Study to determine the optimal level of foliarly applied phosphate needed to decrease lead toxicity and to enhance biomass growth;
- 3) A Soil Leaching Study to determine to what extent leaching may occur as a result of lead solubilization by the chelate.

The Plant Screening and Foliar Applications studies will be conducted in 8-inch plastic pots (containing 4 kg of soil), while the soil leaching study will be conducted in larger containers fitted with a leachate collection system. Each container used in the soil leaching study measures 6 X 6 inches in width and is 24 inches in length and contains approximately 25 kg of soil. An overview of the experimental designs for these studies is provided in Table 4-8.

**Table 4-6**  
**Experimental Design Details for the Chelate Applications Study**

Soil Source	Crop	Chelate Concentrations and Soil pH	Volume of Water for Chelate Application	Time Periods	Number of Replicates	Sampling Soil Depths	Chemical Analyses	Number of Soil Samples
Cell 1	Indian Mustard	Best from Chelate Screening Study	1.5 X WHC <sup>1</sup>	1 Day	2	5	See Table 4-7	10
"	"	"	1.5 X WHC <sup>1</sup>	1 Week	2	5		10
"	"	"	1.5 X WHC <sup>1</sup>	2 Weeks	2	5		10
"	Indian Mustard	Best from Chelate Screening Study	2.0 X WHC <sup>1</sup>	1 Day	2	5	"	10
"	"	"	2.0 X WHC <sup>1</sup>	1 Week	2	5	"	10
Cell 1	"	"	2.0 X WHC <sup>1</sup>	2 Weeks	2	5	See Table 4-7	10
Total								60
Cell 7	Indian Mustard	Best from Chelate Screening Study	1.5 X WHC <sup>1</sup>	1 Day	2	5	See Table 4-7	10
"	"	"	1.5 X WHC <sup>1</sup>	1 Week	2	5		10
"	"	"	1.5 X WHC <sup>1</sup>	2 Weeks	2	5		10
"	Indian Mustard	Best from Chelate Screening Study	2.0 X WHC <sup>1</sup>	1 Day	2	5	"	10
"	"	"	2.0 X WHC <sup>1</sup>	1 Week	2	5	"	10
Cell 7	"	"	2.0 X WHC <sup>1</sup>	2 Weeks	2	5	See Table 4-7	10
Total								60
Grand Total								120

(1) WHC - Water holding capacity of the soil.

**Table 4-7**  
**Chemical Analyses for the Chelate Applications Study**

Sample Type	Minimum Sample Size <sup>1</sup>	Parameter Measured
Soil	50 grams	pH Total Metals (Pb) <sup>2</sup> Plant-available Pb Chelates Moisture

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.
- (2) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.

**Table 4-8**

**An Overview of Experimental Designs for the Greenhouse Studies**

Plant Screening Study

6 plant species

4 chelate levels

2 soil pH levels

3 replicates

**Total: 144 pots x 2 soils = 288 pots**

Foliar Application Study

2 plant species (one warm season and one cool season)

3 phosphate levels

3 replicates

**Total: 18 pots x 2 soils = 36 pots**

Soil Leaching Study

2 best treatments from Plant Screening and Foliar Application Studies  
(species, chelate concentration, soil pH, phosphate fertilization level)

2 soil types

2 replicates for each combination of treatments by soil type

plus

2 controls (1 of each soil)

**Total: 10 containers**

Six plant species will be tested. These plants were selected based on their ability to produce high biomass and to naturally accumulate significant concentrations of lead in the biomass, or both. The species selected are:

- Indian mustard (*Brassica juncea* L.),
- White mustard (*Brassica herda* L.)
- Corn (*Zea mays* L.),
- Sorghum sudan grass (*Sorghum sudanense* L.),
- Alfalfa (*Medicago sativa* L.),
- Sunflower (*Helianthus annus* L.).

These plants represent 4 broad-leafed dicotyledons (alfalfa, the two mustards, and sunflower) and 2 tropical grass monocotyledons (corn and sorghum sudan). The plants further subdivide into cool season (Indian mustard, white mustard, and alfalfa) and warm season (corn, sorghum sudan grass, and sunflower) plant species.

#### **4.5.1 Plant Screening Study**

Details of the experimental design for the Plant Screening Study are provided in Table 4-9. A listing of the chemical analyses to be performed are provided in Table 4-10.

During the Plant Screening Study, six plant species will be screened for lead uptake efficiency. Each crop will be grown, from seed, in pots containing 4 kg of lead-contaminated soil. The potted plants will be placed in a randomized complete block design. Each block will contain all treatment variables including soil type. Individual replicates within blocks will be re-randomized each week. Based on the nutrient analysis obtained for sampling the bulk soil, all crops will initially receive the optimum fertilization rates (minus phosphate) dependent on crop requirements. To ensure that nutrient deficiency will not limit plant growth, an additional mid-season fertilizer application will be made. Moisture retention/release curves will be determined (See method in Appendix B-18) for each soil to ensure adequate water additions throughout the growing season of each crop. Data will be maintained on each crop to document overall plant health.

Table 4-9

## Experimental Design Details for the Plant Screening Study

Soil Source	Crop	Chelate Concentration	Soil pH	Number of Replicates	Chemical Analyses	Number of Soil Samples <sup>1</sup>	Number of Aerial Plant Samples <sup>2</sup>
Cell 1	Indian Mustard	0, 33, 66, and 100 % of Max	Natural & pH 5.5	3	See Table 4-10	24	24
"	White Mustard	"	"	3	"	24	24
"	Corn	"	"	3	"	24	24
"	Sorghum sudan grass	"	"	3	"	24	24
"	Alfalfa	"	"	3	"	24	24
Cell 1	Sunflower	0, 33, 66, and 100 % of Max	Natural & pH 5.5	3	See Table 4-10	24	24
Total							144
Cell 7	Indian Mustard	0, 33, 66, and 100 % of Max	Natural & pH 5.5	3	See Table 4-10	24	24
"	White Mustard	"	"	3	"	24	24
"	Corn	"	"	3	"	24	24
"	Sorghum sudan grass	"	"	3	"	24	24
"	Alfalfa	"	"	3	"	24	24
Cell 7	Sunflower	0, 33, 66, and 100 % of Max	Natural & pH 5.5	3	See Table 4-10	24	24
Total							144
Grand Total							288

(1) Soil samples taken post-harvest.

(2) Aerial plant samples taken at harvest.

**Table 4-10**  
**Chemical Analyses for the Plant Screening Study**

Sample Type	Minimum Sample Size <sup>1</sup>	Parameter Measured
Soil	7 grams	Total Metals (Pb) <sup>2</sup> Plant-available Pb
Plant (aerial: control groups) <sup>3</sup>	4 grams	Total Metals (Pb) <sup>2</sup> Total P <sup>3</sup>
Plant (aerial: all others)	2 grams	Total Metals (Pb) <sup>2</sup>

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC programs.
- (2) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.
- (3) Analyze the "best" warm and cold weather species in the control group (the sample grouping with zero chelate concentration and natural soil pH). A total of six samples will be obtained. The analyses will be used during the Foliar Application Study to determine whether the existing soils are providing sufficient phosphorus to support growth (phosphorus content of 0.3-0.4% of the plant dry weight).

For planning purposes it is assumed that the plants will reach full vegetative biomass in approximately eight weeks. After eight weeks, the soil pH in half the pots will be adjusted to pH 5.5, using an amount of acetic acid determined from a buffer curve of soil pH verses acetic acid additions, to increase lead solubility in the soil. Assuming lead is present in soil as certain mineral phases, calculations then will be made with a chemical speciation program (MINEQL+) to predict what concentration of chelate in soil would maximize lead solubility at the indigenous pH and at the adjusted pH. The chelate then would be applied to the soil at 0, 33%, 66%, and 100% of this calculated concentration. The combination of soil acidification and chelate application will increase lead solubility in the soil and thus provide for enhanced plant uptake of soil lead. The chelate is expected to accelerate lead accumulation to the point of plant toxicity. After senescence and death, the plants will be harvested, dried, weighed for yield determination, ground, and analyzed for total lead content. Post-harvest soil samples will be taken and analyzed for total and plant-available lead content. The data will be used to statistically determine overall plant species efficiency for lead removal on each soil.

In addition, an analysis for total P will be run on the "best" warm and cold weather species in the control groups (groups with zero chelate concentration). These analyses will be used during the Foliar Application Study to determine whether the existing soils are providing sufficient phosphorus to support growth.

#### **4.5.2 Foliar Application Study**

Details of the experimental design for the Foliar Application Study are provided in Table 4-11. A listing of the chemical analyses to be performed are provide in Table 4-12.

The experimental protocol and procedure for this study are essentially the same as for the Plant Screening Study. The two best plant species from the Plant Screening Study (one warm weather plant and one cold weather plant) will be used as the test crops. A phosphate fertility variable (foliar application at 3 levels) will be imposed to ameliorate lead toxicity to the plants and to maximize biomass production and lead uptake. Phosphate application levels will be estimated for each species from values in the literature. The phosphate will be foliarly applied (i.e. applied to the plant's leaves) using a fine mist sprayer. The application is expected to prevent complexation of soil lead as insoluble  $Pb-PO_4$  complexes and to likewise prevent phosphate from

Table 4-11

## Experimental Design Details for the Foliar Application Study

Soil Source	Crop	Chelate Concentration	Soil pH	Phosphate Application Level <sup>1</sup>	Number of Replicates	Chemical Analyses	Number of Soil Samples <sup>2</sup>	Number of Aerial Plant Samples <sup>3</sup>
Cell 1	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Control (No P)	3	See Table 4-12	3	3
"	"	"	"	1 X Min. Req.	3	"	3	3
"	"	"	"	2 X Min. Req.	3	"	3	3
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Control (No P)	3	"	3	3
"	"	"	"	1 X Min. Req.	3	"	3	3
"	"	"	"	2 X Min. Req.	3	See Table 4-12	3	3
Cell 1						Total	18	18
Cell 7	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Control (No P)	3	See Table 4-12	3	3
"	"	"	"	1 X Min. Req.	3	"	3	3
"	"	"	"	2 X Min. Req.	3	"	3	3
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Control (No P)	3	"	3	3
"	"	"	"	1 X Min. Req.	3	"	3	3
"	"	"	"	2 X Min. Req.	3	See Table 4-12	3	3
Cell 7						Total	18	18
						Grand Total	36	36

- (1) Min. Req. : Refer to the minimum phosphate application required using foliar techniques to increase the phosphorus content of the plants to 0.3-0.4%.
- (2) Soil samples taken post-harvest.
- (3) Aerial plant samples taken during harvest.

**Table 4-12**  
**Chemical Analyses for the Foliar Application Study**

Sample Type	Minimum Sample Size <sup>1</sup>	Parameter Measured
Soil	10 grams	Total Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>2</sup> Total Metals (Hg) <sup>2</sup> Total Metals (Se) <sup>2</sup> Plant-available Pb
Plant (aerial)	7 grams	Total Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>2</sup> Total Metals (Hg) <sup>2</sup> Total Metals (Se) <sup>2</sup> Total P

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.
- (2) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.

becoming unavailable to the plant. Applications will be made twice during the growing season, with the last application being made one week before soil pH adjustment and chelate additions. Plant and soil samples and data will be handled in the same fashion as in the plant screening study. However, in this study, soil and plant samples will be analyzed for the other metals detected in the initial soil analysis as well as for lead.

#### **4.5.3 Soil Leaching Study**

The Soil Leaching Study will examine whether chelate-induced lead solubilization will result in soil leaching. The study will incorporate information over two growing periods: one ten-week period in which chelate is added to soil at full biomass (approximately week eight), and a subsequent ten-week period in which the impact of residual chelates will be tracked. Unlike the Foliar Applications Study, metal analysis in this study will be limited to three metals (lead and two other metals). Metals other than lead will be selected on the basis of their concentration in the soil relative to the permissible exposure limit (PEL) for each metal. If the PEL is not exceeded, then selection will be based on solubility in the chelator. Details of the experimental design for the first growth period of the Soil Leaching Study are provided in Table 4-13, similar information for the second growth period are provided in Table 4-14. A listing of the chemical analyses to be performed are provided in Table 4-15.

The experimental procedures for this study are essentially the same as for the foliar application study. The study will be conducted using the parameters selected as optimal in the plant screening and foliar application studies (i.e., the two best plant species, chelate level, soil pH level, and phosphate level). However, larger containers (6 X 6 inches in width and 36 inches in length) will be used to allow study of leaching. The increased soil volume will maximize rooting depth, root interception of mobilized metals, and increase the extent of soil reaction with leaching lead. Thus, a more realistic assessment of the risk for lead leaching can be made.

It should take about eight weeks for the plants to reach full vegetative biomass. After the plants reach full vegetative biomass, and prior to addition of the chelate, the pH of the soil in each container will be adjusted to a predetermined value using acetic acid. Soil samples will be taken immediately prior to chelate addition and at final harvest two weeks later. A sequential

Table 4-13

Experimental Design Details for the 1<sup>st</sup> Growing Season of the Soil Leaching Study

Soil Source	Crop	Chelate Concentration	Soil pH	Phosphate Application Level	Number of Replicates & Soil Depths	Chemical Analyses	Number of Soil Samples <sup>1</sup>	Number of Leaching Samples <sup>2</sup>	Number of Plant Samples <sup>3</sup>
Cell 1	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Best from Foliar Application Study (warm weather)	2 reps 4 depths	See Table 4-15	2 reps X 4 depths X 2 sample times = 16	18 samples X 2 reps = 36 total	2 reps X 2 samples = 4 total
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Best from Foliar Application Study (cold weather)	2 reps. 4 depths	"	16	36	4
Cell 1	None	None	Natural	None	1 reps 4 depths	See Table 4-15	8	18	2
						Total	40	90	10
Cell 7	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Best from Foliar Application Study (warm weather)	2 reps 4 depths	See Table 4-15	2 reps X 4 depths X 2 sample times = 16	18 samples X 2 reps = 36 total	2 reps X 2 samples = 4 total
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Best from Foliar Application Study (cold weather)	2 reps. 4 depths	"	16	36	4
Cell 7	None	None	Natural	None	1 reps 4 depths	See Table 4-15	8	18	2
						Total	40	90	10
						Grand Total	80	180	20

(1) Soil taken both pre and post harvest.

(2) Leachate samples obtained from each replicate once every two weeks prior to adding soil amendment (4 times/crop) and every day afterward (14 times/crop).

(3) Both aerial and root samples are taken during harvest.

Table 4-14

Experimental Design Details for the 2<sup>nd</sup> Growing Season of the Soil Leaching Study

Soil Source	Crop	Chelate Concentration	Soil pH	Phosphate Application Level	Number of Replicates & Soil Depths	Chemical Analyses	Number of Soil Samples <sup>1</sup>	Number of Leaching Samples <sup>2</sup>	Number of Plant Samples <sup>3</sup>
Cell 1	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Best from Foliar Application Study (warm weather)	2 reps 4 depths	See Table 4-15	2 reps X 4 depths X 1 sample time = 8	10 samples X 2 reps = 20 total	2 reps X 2 samples = 4 total
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Best from Foliar Application Study (cold weather)	2 reps. 4 depths	"	8	20	4
Cell 1	None	None	Natural	None	1 reps 4 depths	See Table 4-15	4	10	2
						Total	20	50	10
Cell 7	Best warm weather crop from Plant Screening Study	Best from Plant Screening Study (warm weather)	Best from Plant Screening Study (warm weather)	Best from Foliar Application Study (warm weather)	2 reps 4 depths	See Table 4-15	2 reps X 4 depths X 1 sample time = 8	10 samples X 2 reps = 20 total	2 reps X 2 samples = 4 total
"	Best cold weather crop from Plant Screening Study	Best from Plant Screening Study (cold weather)	Best from Plant Screening Study (cold weather)	Best from Foliar Application Study (cold weather)	2 reps. 4 depths	"	8	20	4
Cell 7	None	None	Natural	None	1 reps 4 depths	See Table 4-15	4	10	2
						Total	20	50	10
						Grand Total	40	100	20

(1) Soil taken both pre and post harvest.

(2) Leachate samples obtained from each replicate every week (10 times/crop).

(3) Both aerial and root samples are taken during harvest.

**Table 4-15**  
**Chemical Analyses for the Soil Leaching Study**

Sample Type	Minimum Sample Size <sup>1</sup>	Preservative Added	Parameter Measured
Soil	45 grams <sup>2</sup>	None	pH Total Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>3,4</sup> Total Metals (Hg) <sup>3,4</sup> Total Metals (Se) <sup>3,4</sup> Total Metals by Sequential Analysis <sup>3</sup> Plant-available Pb Chelates
Leachate	215 ml	Filtered <sup>5</sup> then Nitric Acid added. (until pH <2)	Total Dissolved Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>3</sup> Total Dissolved Metals (Se) <sup>3</sup> Total Dissolved Metals (Hg) <sup>3</sup>
Plants (aerial and root)	10 grams <sup>2</sup>	None	Total Metals (Pb, Cd, Cu, Ni, Zn, Cr) <sup>3,4</sup> Total Metals (Hg) <sup>3,4</sup> Total Metals (Se) <sup>3,4</sup> Total Pb by Sequential Analysis <sup>3</sup> or Scanning Electron Microscope

- (1) Every tenth sample will contain twice the usual amount of sample and be submitted for use in the QA/QC program.
- (2) Includes preliminary estimate of 5 grams/sample for sequential analysis. These estimates are subject to revision.
- (3) Metal analysis will be limited to lead and two other metals. The other two metals will be those most likely to exceed the permissible exposure limit (PEL). If the PEL is not likely to be exceeded then selection will be based on solubility in the chelator.
- (4) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.
- (5) Filtered through Whatman #2 or equivalent.

extraction procedure (Appendix B-15), consisting of progressively stronger soil extractants, will be used on the soil samples to determine the form of metal present in the treated and untreated soil. After the plants are harvested, the soil will be sampled at four depths and analyzed for total lead, plant-available lead, and other metals found in the initial soil analysis. The post-harvest soil samples also will be analyzed for chelate concentration.

Plant samples (roots and aerial portions) will be taken immediately prior to chelate addition and at final harvest two weeks later. These samples will be analyzed for total lead and other metals found in the initial soil analysis. An additional set of plant samples (both root and shoot) will be taken at final harvest and subjected to a sequential analysis procedure (Appendix B-16) to determine the form of lead contained in the plants. In addition, the potential of using an environmental scanning electron microscope equipped with energy dispersive X-ray detector (EDX) will be evaluated for its capability to detect the location of Pb and other metals in the plant cell structure and to quantify the metals concentration in the plant tissue (Appendix B-20). If this method proves to be effective, it will replace the plant sequential extraction procedure. In this case, procedures for the SEM-EDX method will be provided at a later date. Analysis of the plant samples may explain why, in most plants, lead tends to concentrate in the roots and is not translocated to the aerial portions of the plant in the absence of chelators, whereas amending the soil with chelators has been found to enhance translocation of lead to the plant shoots.

Each container will be fitted with a leachate collection system consisting of a heavy duty plastic bag connected to a central drain. A suitable support system will be constructed for the container and the leachate collection bag. Soil leachates will be collected from the containers once every two weeks prior to the addition of soil amendments, and every day after the amendments are added. The amount of leachate will be measured, recorded. A subsample will be taken for analysis. The excess leachates then will be placed into a holding container for disposal.

After the plants are harvested, the soil will be replanted and the study repeated to determine:

- The effects of residual soluble lead on the germination and growth of a subsequent crop.
- Plant uptake of residual solubilized lead.
- Leaching of residual solubilized lead or other metals.

The leachate collection regime will differ from the previous growth period. Instead of every two weeks, the leachate will be collected weekly. When plants realize full vegetative biomass, they will be harvested and analyzed for lead and other metals. Soil samples at four depths will be analyzed for total lead, plant-available lead, other metals, and chelator concentration.

## SECTION 5.0

### SAMPLING PLAN

#### 5.1 Overview of Sampling Operations

Field sampling operations will be performed for the following purposes:

- Characterize and map SFAAP sites for soil type and degree of heavy metal contamination via collection of multiple soil cores at various depths at two contaminated areas.
- Collection of a bulk quantity of soil, from a suitable location within each SFAAP site, for use in laboratory and greenhouse studies. A suitable location is defined as a site with lead contamination levels of 3,000 to 4,000 ppm in the top foot of soil.

Laboratory and greenhouse sampling operations will be performed for the following purposes:

- Collection and analyses of soil samples during laboratory studies to select chelates to be used in the greenhouse studies and to optimize chelate effectiveness in solubilizing lead and other metals in soil.
- Collection and analyses of soil samples to determine chelate persistence and movement in soil.
- Collection and analyses of plant and soil samples in greenhouse studies to determine the plant species with the highest efficiency for lead removal, and to determine the amounts and form of lead remaining in soil after plant harvest for each species studied.
- Collection and analyses of plant and soil samples in greenhouse studies to determine the effect of phosphate in ameliorating lead toxicity to plants.

- Collection and analyses of plant, soil, and leachate samples in greenhouse studies after optimization of other experimental parameters to assess the risk of lead and metals leaching after chelate additions.

## **5.2 Sample Collection and Laboratory Procedures**

### **5.2.1 Soil Sampling Procedures for Initial Characterization**

Initial field sampling will be conducted on an explosives burning ground located at the Sunflower Army Ammunition Plant in Desoto, Kansas. Two sites have been selected for soil sampling, one site will be located in Cell 1 and the other in Cell 7 (Figure 1-1).

Soil sampling will be performed by TVAE personnel. Safety precautions and site controls to be used during the sampling procedure are outlined in the Health and Safety Plan. The sampling procedure, conducted by TVAE personnel, will be as follows:

1. Select and mark an area measuring 90 feet by 90 feet within each of Cell 1 and Cell 7.
2. Subdivide the area into 36 fifteen-foot square grids.
3. Further subdivide each fifteen-foot grid into four seven and one-half foot squares.
4. Take one soil core to a depth of 12 inches from each 7.5 foot square and subdivide this core by depth into two portions (0-6, and 6-12 inches). Composite cores taken from the four 7.5 foot squares, according to depth, into one sample for each depth and place it into an appropriately identified and labeled plastic bag (Ziploc™ type).
5. Package samples for shipment to ERC and transfer to the TVAE's Greenhouses at the Environmental Applications Analytical Laboratories (EAAL) in Muscle

Shoals, AL, in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody").

A total of 144 samples will be taken (36 grids/site x 2 depths/sample core x 2 sites = 144). Upon leaving the sampling site all TVAE personnel involved in the sampling procedure will undergo decontamination in accordance with the Health and Safety Plan. The sampling plan is provided in Appendix C-1.

The collected soil samples will be air dried by opening the plastic bag and folding down the top to permit sufficient air movement. The opened bags will be placed on tables in the greenhouse and allowed to dry for one week with periodic mixing of the soil in the bag. Following this, they will be analyzed for the parameters shown in Table 4-1 by the methods shown in Table 5-1.

#### **5.2.2 Sampling Procedures for Bulk Soil Collection and Processing**

Based on the criteria of soil texture and total lead content, bulk quantities of soil will be collected by TVAE personnel from two of the sites identified in Section 5.2.1 (1000 kg collected per site). The soil will be collected by shoveling into 55 gallon steel drums lined with a heavy duty plastic barrel liner. Soil sampling will be performed by TVAE personnel. Safety precautions and site controls to be used during the sampling procedure are outlined in the Health and Safety Plan. The soil in each drum will be labeled appropriately for identification and for DOT regulatory requirements for hazardous waste shipment, and shipped by best available method to the ERC greenhouse in Muscle Shoals, AL. A copy of the sampling plan to be sent with TVAE personnel is provided in Appendix C-2

Once received, the soil will be processed for use in laboratory and greenhouse studies by passing the soil through a gasoline-powered soil shredder fitted with a one-quarter inch stainless steel screen. The soil will be thoroughly mixed and twelve subsamples will be taken for analysis and characterization as described in Table 4-2 by the methods listed in Table 5-1. The soil then will be rebarreled at the existing moisture content and stored with appropriate labels until use. Safety precautions, engineering controls, and site controls will be used which are consistent with the ERC's Health and Safety and Chemical Hygiene Plans. All activities, except chemical analysis, will be conducted at the ERC greenhouse to minimize the possibility of contamination.

**Table 5-1****Soil Analyses: Outline of Parameters Analyzed and Method**

<b>Parameter Measured</b>	<b>Extraction or Preparation Method</b>	<b>Analytical Method</b>
pH	N/A	ASA 12-2.6
Total Organic Carbon (TOC)	N/A	415 Series
Total Kjeldahl Nitrogen (TKN)	N/A	351 Series
Exchangeable P	ASA 24-5.2	6010A
Exchangeable K	ASA 9-3.1	6010A
Exchangeable Ca	ASA 9-3.1	6010A
Exchangeable Mg	ASA 9-3.1	6010A
Exchangeable Al	ASA 9-4.2	6010A
DTPA-extractable Fe	ASA 17-4.3	6010A
DTPA-extractable Mn	ASA 17-4.3	6010A
Total Metals (Cd, Cu, Ni, Zn, Cr , Pb) <sup>1</sup>	3050A	6010A
Total Metals (Hg) <sup>1</sup>	7471A	7471A
Total Metals (Se) <sup>1</sup>	7740	7740
Plant-available Pb	ASA 21-5	6010A
Total Metals by Sequential Analysis	(2)	6010A
Chelates	TVA HPLC Method	TVA HPLC Method
Moisture	N/A	ASA 21-2.2.2
Moisture Release Curves	N/A	ASA 8-2.3

- 1) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.
- 2) Sequential extraction of metals in soil will be performed by the method outlined in: Tessier, A., P.G.C. Campbell and M. Bisson. 1979. Sequential extraction procedure for the speciation of particulate trace metals. Anal. Chem. 51:844-850. (See Appendix B-15).

### **5.2.3 Soil Sampling Procedures for Laboratory Studies**

For laboratory studies, an amount of soil will be removed from a selected barrel, weighed and recorded as to the amount removed, placed in an appropriately identified and labeled plastic bag (Ziploc™ type) and transported to the Environmental Applications Analytical Laboratory (EAAL) in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody," Appendix B-1).

### **5.2.4 Soil Sampling Procedures for Greenhouse Studies**

For a given greenhouse study, sufficient soil will be taken from the appropriate barrels (located at the greenhouse); placed on a heavy plastic sheet, or tarp, on a concrete floor; and thoroughly mixed. Small samples will be taken for moisture determination and if necessary, the moisture content of the soil will be adjusted to one-fourth to one-third of field capacity for best handling in subsequent greenhouse operations. The soil then will be covered with plastic to prevent any appreciable moisture loss until used in plant screening, foliar application, and soil leaching studies.

In the Plant Screening and Foliar Application Studies, soil will be sampled post-harvest. Sampling will be performed by taking three full-depth cores from the pot with a standard hand soil sampler. The cores will be composited to provide one soil sample from each pot. The soil samples will be air dried in open Ziploc™ type plastic bags as described previously, screened through a 2.0mm mesh stainless steel wire screen, then transported to the EAAL for analyses in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody", Appendix B-1).

In the soil leaching study, soil samples will be taken both pre- and post-harvest. Pre-harvest samples will be taken immediately prior to soil amendment additions by removing three full depth cores from each container. The cores will be subdivided by depth (0-3, 3-6, 6-12, 12-18, and 18-24 inches) and composited into one sample for each depth. The composited samples will be placed in Ziploc™ type plastic and transported to the EAAL for analysis. Core holes will be filled with a sealed PVC tube before acidifier and chelate additions. The post-harvest samples

will be taken in similar fashion and transported to the EAAL for analysis. All samples will be transported in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody," Appendix B-1). Core holes from post-harvest soil sampling will be filled with sealed PVC tubes, and will remain in place during replanting and growth of the second crop. Soil sampling conducted after the containers have been replanted will be conducted in the same way.

#### **5.2.5 Plant Sampling Procedure**

In the studies involving plant sampling, the total aerial portions of the plants will be harvested from the pots when senescence, or death, occurs following the addition of the soil amendments. During the soil leaching study, both root and shoot samples will be taken pre- and post-harvest. For pre-harvest root sampling, roots will be extracted as cores using a standard hand soil sampler. Roots will be thoroughly washed, then rinsed in deionized water. Plant tissue from individual treatments will be placed into appropriately labeled brown paper bags and oven dried for 72 hours at 55 degrees Celsius. The tissue will be weighed for yield determinations, then ground to less than 2.0mm particle size using a Wiley Mill equipped with stainless steel blades and screens. The dried, ground tissue will be stored in glass bottles and transferred to the EAAL in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody", Appendix B-1). Plant materials will be analyzed by the methods listed in Table 5-2.

#### **5.2.6 Leachate Sampling Procedure**

During the first growth period of the soil leaching study, soil leachates will be collected from the containers every two weeks prior to the addition of soil amendments and every day after amendment addition. After plant harvest, the containers will be replanted, and the leachate collected weekly. When the plants reach full vegetative biomass the experiment will be concluded. The leachates will be collected from a drain in the plant containers into a suitable size heavy-duty plastic bag. The amount of leachate will be measured and recorded. The leachate will then be filtered through a Whatman #2 filter, or it's equivalent, and acidified with nitric acid to a pH of 2 or less. A subsample will be taken to the EAAL for analysis, and the

**Table 5-2**

**Plant analyses: Outline of Parameters Analyzed and Method**

<b>Parameter Measured</b>	<b>Extraction or Preparation Method</b>	<b>Analytical Method</b>
Total Metals (Cd, Cu, Ni, Zn, Cr, Pb) <sup>1</sup>	3050A	6010A
Total Metals (Hg) <sup>1</sup>	7471A	7471A
Total Metals (Se) <sup>1</sup>	7740	7740
Total Metals (Pb) <sup>1</sup>	3050A	6010A
Total Pb by Sequential Analysis	(2)	6010A
Total P	3050A	6010A

- 1) The term "Total Metals" for any element refers to an analysis following an acid digestion of the sample and is used to distinguish it from metals measured following a leaching process.
- 2) Sequential extraction of Pb in plants will be performed by a modification of the methods outlined in:
  - Chemical Aspects of Metal Hyperaccumulation; by Roger D. Reeves, Department of Chemistry and Biochemistry, Massey University, Palmerston, New Zealand.
  - The Distribution of some Inorganic Elements in Plant Tissue Extracts; by H. J. M. Bowen, P.A. Cawse, and J. Thick; Journal of Experimental Botany, Vol. 13, No. 38, pp 257-67, May 1962.

**Table 5-3**

**Leachate analyses: Outline of Parameters Analyzed and Method**

<b>Parameter Measured</b>	<b>Preparation Method</b>	<b>Analytical Method</b>
Total Dissolved Metals (Pb, Cd, Cu, Ni, Zn, Cr)	3005A	6010A
Total Dissolved Metals (Se)	7740	7740
Total Dissolved Metals (Hg)	7470 or 3005A	7470 or 6010A

leachates then will be placed into a holding container until disposal. Leachates collected during the preliminary laboratory studies will be processed similarly. All samples will be transferred to the EAAL in accordance with TVAE's chain of custody procedures (EAAL procedure SP-0001, "Sample Chain of Custody," Appendix B-1). Plant materials will be analyzed by the methods listed in Table 5-3.

#### **5.2.7 Laboratory Procedures**

Standard operating analytical procedures for data collected in the laboratory are provided in Appendices B-1 through B-19.

#### **5.2.8 Sample Storage, Packaging, and Shipping**

All samples shall be handled in accordance with EAAL procedure SP-0001, "Sample Chain of Custody" (Appendix B-1). In addition, all leachate samples will be filtered and preserved with nitric acid. Sufficient nitric acid will be added to the leachate samples to lower the pH below 2.

No attempt shall be made to store samples or sample extracts beyond that period of time required for initial assessment and review of laboratory data.

#### **5.2.9 Laboratory Equipment**

The equipment used for analyzing samples is outlined in Table 5-4.

#### **5.3 Sampling Documentation**

Field sampling logs will be produced and completed at the time of sampling to ensure dates, times, locations, and other pertinent data and conditions are recorded. Sample identification numbers will be written on both the sample containers and sample log sheet for easy identification and cross referencing. Sample identification codes or numbers will be assigned in a logical manner to ensure ease in correlating between codes and sampling locations.

**Table 5-4****Laboratory Equipment Used**

<b>Laboratory Data</b>	<b>Equipment</b>
Chelates	Varian HPLC
DTPA-extractable Fe and Mn	Perkin Elmer or Thermo Jarrel Ash ICP
Exchangeable P, K, Ca, Mg, and Al	Perkin Elmer or Thermo Jarrel Ash ICP
TKN	Lachat Quick Chem 8000 or Technicon AutoAnalyzer II
Total Organic Carbon (TOC)	Dohrmann DC 190
Total Metals (Pb, Cd, Cu, Ni, Zn, Cr)	Perkin Elmer or Thermo Jarrel Ash ICP
Total Metals (Hg)	Cold Vapor Atomic Absorption or Perkin Elmer or Thermo Jarrel Ash ICP
Total Metals (Se)	Graphite Furnace Atomic Absorption or Perkin Elmer or Thermo Jarrel Ash ICP
Total Lead (Pb)	Perkin Elmer or Thermo Jarrel Ash ICP
Plant-available lead (Pb)	Perkin Elmer or Thermo Jarrel Ash ICP
Total Metals by Sequential Analysis	Perkin Elmer or Thermo Jarrel Ash ICP
Total Pb by Sequential Analysis	Perkin Elmer or Thermo Jarrel Ash ICP
pH	Orion meter or equivalent

## SECTION 6.0

### RESULTS AND REPORTS

#### 6.1 Coverage

At the conclusion of this study, TVAE will prepare a results report and submit it to the USAEC. The report will cover all test activities under the current plan plus any other activities that may arise from mid-course plan changes.

The purpose of the results report will be to communicate: (1) all test, sampling, and analytical procedures in sufficient detail such that the USAEC or any other technically skilled organizations could repeat the procedures; (2) a full and detailed accounting of all test results; (3) all conclusions that can be derived from the results; (4) recommendations for further test work, and (5) the specifications for designing a field demonstration.

The report will include, but will not be limited to, the following topics and features:

- Methods development, which covers all specialized laboratory or test methods developed to facilitate the test plan. A description of the manner in which each new method was developed and the rationale for its efficacy will be included.
- Test procedures used in the field.
- Sampling and analytical procedures.
- QC methods used in the field and in the analytical laboratory.
- QC results from field sampling and laboratory analysis.
- Test results—data evaluation, graphical and tabular presentations of data.

- Photographs necessary to enhance an understanding of the equipment arrangements, the test and sampling procedures, the arrangement of test items, and visual evidence of the test results.
- Conclusions
- Recommendations

## **6.2 Format**

The report will be presented in a standard technical format, with USAEC's official front cover and "Report Documentation Page" for identification. The report's sections and subsections will be designated numerically (as is done in this test plan) in order to facilitate referencing of the report on oral and written communications.

## SECTION 7.0

### QUALITY ASSURANCE PLAN

#### 7.1 Purpose and Scope of the Plan

The quality assurance plan outlines procedures to ensure that:

- Sufficient measurements are made to assess the effectiveness of the proposed treatment methods
- Samples taken are representative of the conditions in the experimental setup
- Samples are delivered to the laboratory for analysis without deterioration
- Samples are processed by the laboratory without deterioration prior to analysis
- Measurement techniques are sufficiently specific to measure the target compounds
- Data taken are reliable.

The quality assurance plan applies to all activities including performing experiments, sampling, and laboratory analysis of samples.

## 7.2 Project Responsibilities

Figure 7-1 shows the TVAE organizations providing support to the project. Responsibilities of the TVAE project team are as follows:

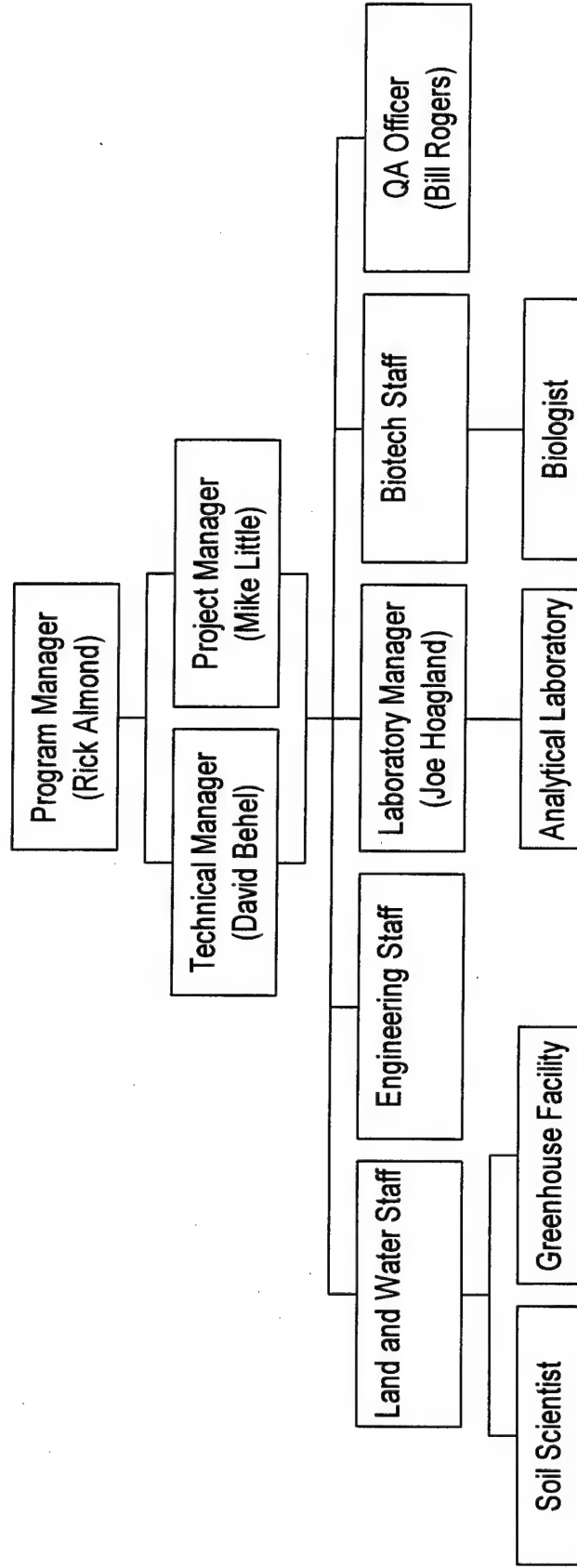
The Program Manager is responsible for providing guidance to the project team to ensure that the AEC and TVAE project and program goals are met. The Program Manager is also responsible for resolving any inconsistencies between AEC and TVAE mission objectives and those of the project/program.

The Project Manager is responsible for overall direction of the project and is responsible for oversight and direction of staffing levels, process design, construction, installation, field process operations, technical reports, preparation and presentation of technical papers, and conducting briefings of USAEC personnel. The Project Manager is responsible for providing direction and executing tasks to ensure that project goals are met, reports are delivered on schedule, and that task schedules and costs are met. The Project Manager ensures that any variances are adequately explained.

Technical Manager is responsible for planning, directing, and executing the details of process design, construction, installation, experimental design, field process equipment operation, sampling, documentation, data integrity, data interpretation, technical reports, preparation and presentation of technical papers, and conducting briefings of USAEC personnel.

The Engineering Staff reports to the Project Manager and is responsible for various project management tasks including: project planning, cost estimating, scheduling, technical writing, compiling/editing of reports, and other project management tasks.

Environmental Applications Analytical Laboratory (EAAL) is responsible for providing analytical measurements on samples required in the course of the project and is responsible for review of the data produced, documentation of analytical runs, and ensuring data integrity. The EAAL is managed by the Laboratory manager. The Laboratory Manager reports to the Project and Technical Managers and is responsible for providing project analytical oversight and for final data integrity.



**Figure 7-1**  
**TVAE Organizations Providing Project Support**

In the EAAL, research chemists and research scientists report to the Laboratory Manager and are responsible for planning, design, testing, and documentation of the various sub-projects assigned to them. They are responsible for producing periodic progress reports to the Laboratory Manager. They are responsible for review of data falling under their area of responsibility. Chemical laboratory analysts and technicians assigned to the EAAL report to the Laboratory Manager and are responsible for following procedures and instructions to provide analytical measurements required in the course of the project. They are responsible for review of the data they produce, documentation of analytical runs, and equipment maintenance.

The Quality Assurance Officer is responsible for auditing actions and documentation to ensure adherence to this Plan (Section 7). The Quality Assurance Officer is responsible for providing quarterly quality control data reports to the Project Manager.

Research chemists and research scientists from the Biotech and Land and Water Staffs report to the Technical and Project Managers and are responsible for planning, design, testing, and documentation of the various sub-projects assigned to them. They are responsible for producing periodic progress reports to the Technical Manager. They are responsible for review of data falling under their area of responsibility.

The Greenhouse staff reports to the Technical Manager and are responsible for the day-to-day operations of the greenhouse and related functions.

### **7.3 Quality Program Procedures and Documents**

#### **7.3.1 Documenting Experimental Data**

Experiments shall be planned in advance and documented in writing. This may be done in research notebooks or separate work plans. Data, observations, experimental conditions, and changes to plans shall be recorded in research notebooks in a complete enough fashion that all actions, results, and conclusions may be reconstructed afterwards. All written documents will be written in ink.

### **7.3.2    Procedures for Field Sampling**

Field sampling shall be conducted in accordance with written work plans, procedures, or instructions to ensure complete samples are taken at correct locations and in a manner which does not invalidate conclusions. All actions in field sampling should be recorded in field notebooks or on forms designed to ensure complete documentation of all experimental parameters.

### **7.3.3    Analytical Laboratory QA Manual**

The analytical laboratory portion of the activities covered by this test plan shall be conducted in accordance with the EAAL's Quality Assurance Manual which contains the following documents:

- QAPLAN - "Quality Assurance Plan"
- GLP-0001 - "Procedure Format and Style"
- GLP-0002 - "Quality Assurance Records Control"
- GLP-0003 - "Procedure Preparation and Distribution"
- GLP-0004 - "Training"
- GLP-0005 - "Nonconformances and Corrective Actions"
- GLP-0006 - "Control of Reagents and Standards"
- GLP-0007 - "Analysis Work Plan Preparation"
- GLP-0012 - "Treatment of Data"
- GLP-0013 - "Instrument Logbook and Control Chart Maintenance"
- GLP-0016 - "Sample Receipt, Log-in, and Data Handling"
- GLP-0017 - "Control of Changes to Software"
- CP-0001 - "Measurement and Test Equipment Control and Calibration"
- SP-0001 - "Sample Chain of Custody"

#### **7.3.4 Procedures Policy for Analytical Laboratory Analyses**

Laboratory analyses shall be conducted in accordance with written procedures. Modifications to existing procedures found to be necessary to perform the analyses required in this test plan shall be noted in equipment operation logs or research notebooks until included in revisions to procedures.

#### **7.4 Control of Purchased Items**

Chemicals, equipment, material and other items purchased for the purposes of this test plan shall be of suitable quality to meet the needs of the project. The required quality of items shall be specified in written procedures or work plans. The required quality shall be included in complete purchase requests which shall include all technical specifications needed to meet the needs of the project. Purchased items shall be inspected upon receipt to ensure they meet the requirements as specified in purchase requests. Nonconforming items shall not be used in this project. Suitable handling activities, storage conditions, and other controls shall be utilized to ensure quality of purchased items is not degraded after receipt.

#### **7.5 Records**

##### **7.5.1 Record Control**

Records of analysis, records of calibration, research notebooks, chromatograms, field sampling logs, custody records, work plans, machine printouts, chromatogram traces, logsheets, standard material use records, raw data calculation sheets, and copies of procedures shall be maintained as quality assurance records as specified in GLP-0003. Records shall be accumulated in logical arrangement to facilitate retention and review. In-process records and logbooks shall be stored in the work area in a safe manner to protect against loss, fire, spills, or other damage.

### **7.5.2 Record Retention**

Records of experiments and analyses shall be maintained for a period of three years after the end of the project. This shall include machine printouts or chromatogram traces, logbooks, notebooks, logsheets, standard material use logs, and raw data calculation sheets. Due to the limited lifetime of computer storage media, any computer media utilized to store analytical file backups or raw data files shall be stored for the lifetime of the project plus one year.

## **7.6 Performance and System Audits**

### **7.6.1 Performance Audits**

The EAAL Quality Assurance Officer may introduce unknown quality controls samples at a suitable frequency, provided reference material is available for constructing the samples. (Note: The lack of availability for commercially produced standard reference materials may make this impossible of all analytes). Purchased quality control sample sets from reliable vendors should also be utilized.

Unless problems indicate the need for more frequent checks, a quarterly submission of metals in a liquid matrix, chelates in liquid matrix, purchased QC samples of metals in a soil matrix, and nutrients (ammonia, nitrate, phosphate, total N, total P) in solution will be made. Other internally produced or purchased quality control samples for nutrients and total carbon will be provided as well.

The USAEC may introduce blind quality assurance samples into the analytical stream at their discretion.

Whenever the analyte in an EPA Water Pollution Study is a suitable match for a matrix and analyte in this project, EAAL shall participate in the EPA Water Pollution Study for that analyte. EAAL shall investigate any analyte falling outside control limits and report findings in writing to the QA officer. For this project, the nutrients (ammonia, nitrate, phosphate,

total N, and total P), pH, total carbon, and metals match well enough to be used as performance indicators.

#### **7.6.2 On-Site System Audits**

The EAAL Quality Assurance (QA) Officer will periodically inspect logs, records, printouts, results of quality control checks, documentation, case narratives, research notebooks, and other quality-related aspects of the project to ensure detailed compliance is in effect. Results of these inspections or internal audits will be reported in writing to the EAAL Manager. Nonconformances will be documented and tracked in accordance with EAAL Procedure GLP-0005, "Nonconformance and Corrective Actions."

QA Audits, site inspections, surveillances, or performance evaluations (cross-check samples) may be performed by USAEC during the course of the project.

### **7.7 Quality Assurance Reports**

#### **7.7.1 Status Reports**

The Project Manager will provide monthly progress reports to the USAEC which will contain a summary of accomplishments, a discussion of significant problems, their resolution and plans for the following month.

A quarterly quality control data report shall be written by the EAAL QA Officer addressing:

- Changes in this QA plan
- Changes in analytical procedures
- Summary of QC program results
- Summary of training
- Results of audits
- Results of performance sample evaluations
- Data quality assessment in terms of precision, accuracy, completeness, and MDLs
- Discussion of whether QA objectives were met

### **7.7.2 Audit Reports**

Results of internal audits shall be reported in writing to the Project Manager within 10 working days of the completion of the audit.

### **7.8 Analytical Procedures Policy**

All field measurements shall be done in accordance with manufacturers' methods or instructions.

All analytical work shall be done in accordance with written procedures. Procedures may be those promulgated by EPA, promulgated by another nationally recognized body, or specifically developed at TVAE. Any modifications to approved methods required for this project will be documented in a written modification of the procedure. Any modifications found to be necessary will be reviewed, approved, and promulgated to those performing the work as written procedures in accordance with EAAL Procedure GLP-0001 "Laboratory Procedure Preparation" and GLP-0003, "Procedure Preparation and Distribution."

### **7.9 Analytical Laboratory Calibration and Quality Control**

#### **7.9.1 General Quality Control Requirements**

##### **7.9.1.1 Method Blanks**

EAAL must demonstrate that all glassware and reagents are free of interferences by running method blank samples. Method blanks should include any solvents, acids, or other reagents used in the process.

#### **7.9.1.2 Demonstrating Method Accuracy and Precision**

A quality control check sample (laboratory control sample) containing each analyte of interest but made independently from the calibration standards shall be run four times to demonstrate method accuracy and precision. The average recovery and its standard deviation shall be calculated for each analyte. The recovery should fall between 90 and 110%. The relative standard deviation should be 10% or less. Any analyte which falls outside these limits shall be analyzed again in a similar manner after problems are resolved.

Each analyst must demonstrate the ability to generate acceptable results with the methods by utilizing appropriate proficiency samples or standard reference material.

#### **7.9.1.3 Method Detection Limits**

EAAL must determine method detection limits for each target compound.

#### **7.9.2 Batch QC**

With each batch of 20 samples or subset thereof, one method blank, one matrix spike and one laboratory control sample shall be run. In addition, one sample duplicate or one matrix spike duplicate shall be run with each batch. Note: For some analytical techniques, matrix spikes are not possible. An example of this would be pH measurement.

#### **7.9.3 Quality Control Requirements for HPLC**

##### **7.9.3.1 Retention Time Windows**

Three injections are made of each analyte during a 72-hour period and retention times are determined. Their means and standard deviations are calculated. Plus or minus three standard deviations from the mean value is to be used as the retention time window for each analyte. (Reference section 7.5 of Method 8000A.) When a new column is installed, retention time windows must be determined. Some commercial peak identification software

allows only one window per set of analytes. In this case, the largest window shall be utilized.

#### **7.9.3.2 Initial Calibration Procedures**

For HPLC, calibration will be performed with standards of five concentrations over the range of interest or the range of linear response of the device. The lowest concentration should be approximately equal to the instrument detection limit.

#### **7.9.3.3 Continuing Calibration Procedures**

For HPLC, at the beginning of each day, the midpoint calibration standard will be analyzed. The response factor must be within 15% of the response factor for the initial calibration. If not, the machine will be recalibrated unless other corrections prove effective. Then at least every ten samples and at the end of the run, a midpoint calibration standard will be run. The response factors for these must be within 15% of the initial response factor. Those groups of ten samples preceding and following a midpoint calibration check which fall outside the 15% limits will be reanalyzed after the problem is resolved or a new curve is prepared.

For HPLC, a daily retention time window shall be calculated for each analyte using the mean retention time from the initial midpoint calibration standard plus or minus three standard deviations as determined in the set-up QC section. If the retention time for any analyte from subsequent midpoint calibration standards falls outside the window, those sets of ten samples analyzed preceding and following that midpoint calibration standard must be reanalyzed after the problem is resolved.

A midpoint calibration standard will be run at least every 10 samples and at the end of the run throughout the day. Any group of ten samples preceding and following a midpoint calibration check which falls outside the 15% limits will be reanalyzed.

#### **7.9.4 Quality Control for Automated Laboratory Instrumentation**

The quality control tests required in method 6010A shall be the guidelines for calibration and use of the equipment used in ICP methods. The quality control tests for AA method for calibration and use shall be those specified in the 7000 series methods in SW-846.

For ICP, calibration will be performed with one standard and one blank run at the beginning of each run. For AA, calibration will be performed with three standards and one blank run at the beginning of each run. Following calibration, a calibration check sample and a calibration blank shall be run as required by the method.

Flow injection analyzers shall be calibrated before each use following written procedures or manufacturers' methods. For FIA, calibration shall be performed with standards of five concentrations at the beginning of each day unless a specific method calls for a different number of standards. Concentrations shall bracket the range of interest but shall be limited to the range of linear response of the device.

For any of these devices, a laboratory control sample made from a separate stock than the calibration standards shall be run with each batch. The laboratory control sample may or may not be required to be carried through preparation, depending on the method. For any of these devices, samples exhibiting a signal above the linear range of the device shall be diluted and reanalyzed.

For any of these devices, a midpoint calibration standard will be run at least every 10 samples and at the end of the run throughout the day. Any group of ten samples preceding and following a midpoint calibration check which falls outside the 15% limits will be reanalyzed.

#### **7.10 Data Reduction and Validation**

##### **7.10.1 Data Reduction**

Analytical data reported as a result of this project shall be calculated and reduced on vendor-supplied chromatographic software for HPLC systems and on vendor-supplied analysis

software for FIA systems, ICP systems, AA systems, carbon analyzers, or other automated devices.

EAAL Chemical laboratory analysts are responsible for calculation and reduction of data.

#### **7.10.2 Data Validation**

EAAL group supervisors or team leaders (analytical chemists or research chemists) are responsible for data validation. They are responsible for review and validation of analytical data produced in the project. Group supervisors or team leaders are responsible for decisions concerning reanalysis of samples and shall coordinate with USAEC when significant problems are discovered or when resampling is required.

#### **7.11 Equipment Logbooks**

Equipment logbooks shall be maintained to note instrument settings, operating instructions, problems, corrections, quality control checks, and other data.

#### **7.12 Data Reporting**

##### **7.12.1 Units**

Analytical data are to be reported in units of milligrams per liter for liquid samples. Any results for solid samples should be reported as milligrams per kilogram dry weight. When moisture determinations are not possible, results should be reported as milligrams per kilogram wet weight. In any case, indication shall be given to define what basis was used in reporting results.

Method detection limits and instrument detection limits shall be reported or made available for each run. Recovery of matrix spikes and recovery of quality control samples shall be calculated and reported as percentages.

### **7.13     Data Packages**

Analytical data packages for the project shall include:

- Sample description or identification information.
- Sample analytical results.
- Quality control sample results with percent recovery of known compounds.

Sufficient data will be maintained such that every experiment and analytical result could be reconstructed and every decision in development of the written procedures can be substantiated.

### **7.14     Qualified Data**

Records of all attempts at analysis shall be maintained whether or not the analysis was successful. However, unusable data shall not be reported. Data are unusable when quality control samples or quality control checks fail; however, the records for these attempts at analysis shall be maintained as will the relevant documentation. Under some conditions, data may be reported as not detected even though quality control checks fail. This will be considered sufficient, provided they are properly coded and the technical basis to report them is recorded. The relevant Data Qualification Codes are as follows:

**SM** - Surrogate recovery out of limits. Matrix effect suspected.

**NA** - Compound Not Analyzed

**ND or <MDL** - Compound not detected (value falls less than Method Detection Limit)

**TR or Trace** - Compound present at trace level, indicated but less than MDL.

**MX** - Matrix spike or matrix spike duplicate recovery was outside limits due to suspected matrix effects.

**NDQ** - Compound not detected (value falls less than Method Detection Limit) but quality control checks fell outside acceptance limits.

#### **7.15     Additional QC Samples**

The sampling organization may submit field blanks, field duplicates, reagent blanks, or trip blanks as instructed in the sampling plan. EAAL shall count these as samples in determining batch size.

#### **7.16     Corrective Action**

Corrective actions arising from nonconformances determined in the course of audits or analysis of performance evaluation samples shall be documented and tracked to completion. Other corrective action which falls under the control of an analytical procedure (e.g. adjust a flow rate and reanalyze a sample) need only be tracked in accordance with that procedure.

#### **7.17     Data Quality Parameters for Analytical Laboratory Measurements**

##### **7.17.1     Commonly Used Quality Parameters**

Percent recovery, standard deviation, relative percent difference and other commonly used statistical indicators of accuracy are to be calculated as defined in Chapter 1 of SW-846, 3rd Edition.

##### **7.17.2     Method Detection Limits and Method Quantitation Limits**

Method Detection Limits shall be calculated as defined in Title 40, Code of Federal Regulations, Part 136, Appendix B, "Definition and Procedure for the Determination of the Method Detection Limit " - Revision 1.11.

Method Quantitation Limits are defined as five times the Method Detection Limit as in Chapter 1 of SW-846, 3rd Edition or as the lowest point used in making the calibration curve, whichever is higher.

#### 7.18 Definitions

**Batch** - Usually a group of no more than 20 samples of the same matrix prepared or extracted at the same time with the same reagents.

**Method Blank** - A sample of clean reagent carried through preparation and extraction in the same manner as samples. One method blank is run with each batch.

**Matrix Spike** - An aliquot of a sample spiked with a known concentration of all target analytes. Spike concentration is set to read at five times the method quantitation limit in the sample or about the midpoint of the calibration curve. One matrix spike is run for each batch.

**Matrix Spike Duplicate** - A second aliquot of the same sample treated in the same manner as the matrix spike.

**Duplicate** - A second aliquot of a sample taken independently through extraction and preparation before analysis.

**Quality Control Check Sample** - A quality control sample of the same type and matrix as calibration solutions but made independently from the calibration solutions. This sample is also referred to as a **laboratory control sample**.

## SECTION 8.0

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## APPENDIX A

### HEALTH AND SAFETY PLAN

The enclosed Health and Safety Plan covers activities occurring within the boundaries of the Sunflower Army Ammunition Plant. These activities include: soil sampling and soil excavation. All other activities are covered under TVA's existing Health and Safety procedures.

**HEALTH AND SAFETY PLAN**  
**For**  
**SOIL SAMPLING / EXCAVATION of LEAD CONTAMINATED SOIL**  
**at the**  
**SUNFLOWER AAP, DESOTO, KANSAS**

**Prepared for the**  
**U.S. ARMY ENVIRONMENTAL CENTER**  
*Aberdeen Proving Ground, Maryland 21010-5401*  
**and the**  
**U.S. ARMY CORPS OF ENGINEERS**  
*Kansas City District*

**Prepared by**  
**Tennessee Valley Authority**  
**Environmental Research Center**  
*Muscle Shoals, Alabama 35660-1010*

**September, 1996**  
**TVA Contract No. RG-99712V**

## NOTICE

This Health and Safety Plan for Soil Sampling / Excavation of Lead Contaminated Soil at the Sunflower AAP, Desoto, Kansas, was prepared by employees of the Tennessee Valley Authority (TVA) loaned to the U.S. Army Environmental Center (USAEC) at Aberdeen Proving Grounds, Maryland, 21010-5401, pursuant to the provisions of TVA Contract RG-99712V and Military Interdepartmental Purchase Order Request (MIPR) MIPR 9526.

Under that agreement and MIPR, TVA provided the services mutually agreed upon as loaned employees. In regard to the services provided by the TVA employees, sections d and e of the contract and MIPR state as follows:

- d. TVA will provide the services of mutually agreed upon loaned employees for purposes of the MIPR. It is expressly understood and agreed that services of such loaned employees will be made available, at TVA's discretion, when the schedule for such services is consistent with TVA's requirements and that TVA does not guarantee the availability of such loaned employees' services at any time during the term of this agreement.
- e. It is expressly understood that for all purposes under this MIPR the TVA employees will be acting as loaned employees and will be under the complete supervision and control of the Army at all times and that TVA shall not and cannot supervise or control such employees during the time that they are providing services to the Army. It is further understood and agreed that neither TVA nor any of the loaned employees warrant or guarantee the advice under this agreement and that the Army is solely responsible for determining the suitability and acceptability of such advice and consultations for any purpose. Neither TVA, its agents and employees, nor the loaned employees assume any liability, or responsibility to the Army, its agents, employees, or contractors, or any third party for any costs, charges, damages, (either direct or consequential), demands, claims, or causes of action for any personal injuries (including death) or damage to property, real or personal, or delays arising out of or resulting from any such action or failures to act on the part of such loaned employees whose services are provided under this MIPR.

As provided above, this report was prepared by the TVA loaned employees under direct supervision and control of the U.S. Army. The U.S. Army is solely responsible for its content and use and not TVA, its employees or agents. Wherever it appears in this report, the term "TVA" shall mean TVA loaned employees which are subject to sections d and e quoted.

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14.9	Attachment: Form SR-13 (Jan. 93) Alabama Department of Public Safety.	
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## 1.0 GENERAL

The project is being executed in two phases. In phase I samples of lead contaminated soil will be obtained to characterize the soil's lead concentrations at two locations at the Sunflower Army Ammunition Plant (SFAAP). In phase II approximately two yards of soil will be obtained placed in drums and transferred to the TVA reservation at Muscle Shoals, Alabama. The soil will be used in treatability studies at the TVA reservation. The sampling and excavation procedures will be conducted using hand tools.

The overall risks associated with this project include:

- Moderate risk of encountering explosives when sampling/digging.
- Moderate risk of accidental ingestion of heavy metals contaminated soil.
- Moderate risk of fall and trip hazards.
- Moderate risk of back injury/strains from lifting heavy objects.
- Moderate risk of pinches, scrapes, cuts, and abrasions.
- Moderate risk exists from hazards associated with heat stress (heat cramps, heat exhaustion, heat stroke) and hypothermia.
- Moderate risk of inhalation from dust hazards.
- Low to moderate risk of contact with poisonous plants and animals (i.e. poison ivy, poison oak, snakes, spiders, disease bearing animals, etc.).
- Low to moderate risk of contact with poisonous or disease bearing plants and animals (i.e. poison ivy, poison oak, snakes, spiders, disease bearing animals, etc. )

Risks will be minimized by following safe work practice procedures, standard operating procedures, decontamination procedures during the sampling and excavation phases.

TVA's site manager will report to SFAAP Commanding Officer with indirect reporting to SFAAP Safety Director. All TVA field personnel will be under functional control of TVA's site manager.

## **2.0     KEY PERSONNEL**

### **Sunflower Army Ammunition Plant:**

<b>Position</b>	<b>Name</b>	<b>Phone Number(s)</b>
Administrative Contracts Officer (ACO)	Tom Stutz	(913) 583-3000 Ext. 6789
SFAAP Safety Director	Chuck Jarrett	(913) 583-3000 Ext. 6788

### **Tennessee Valley Authority:**

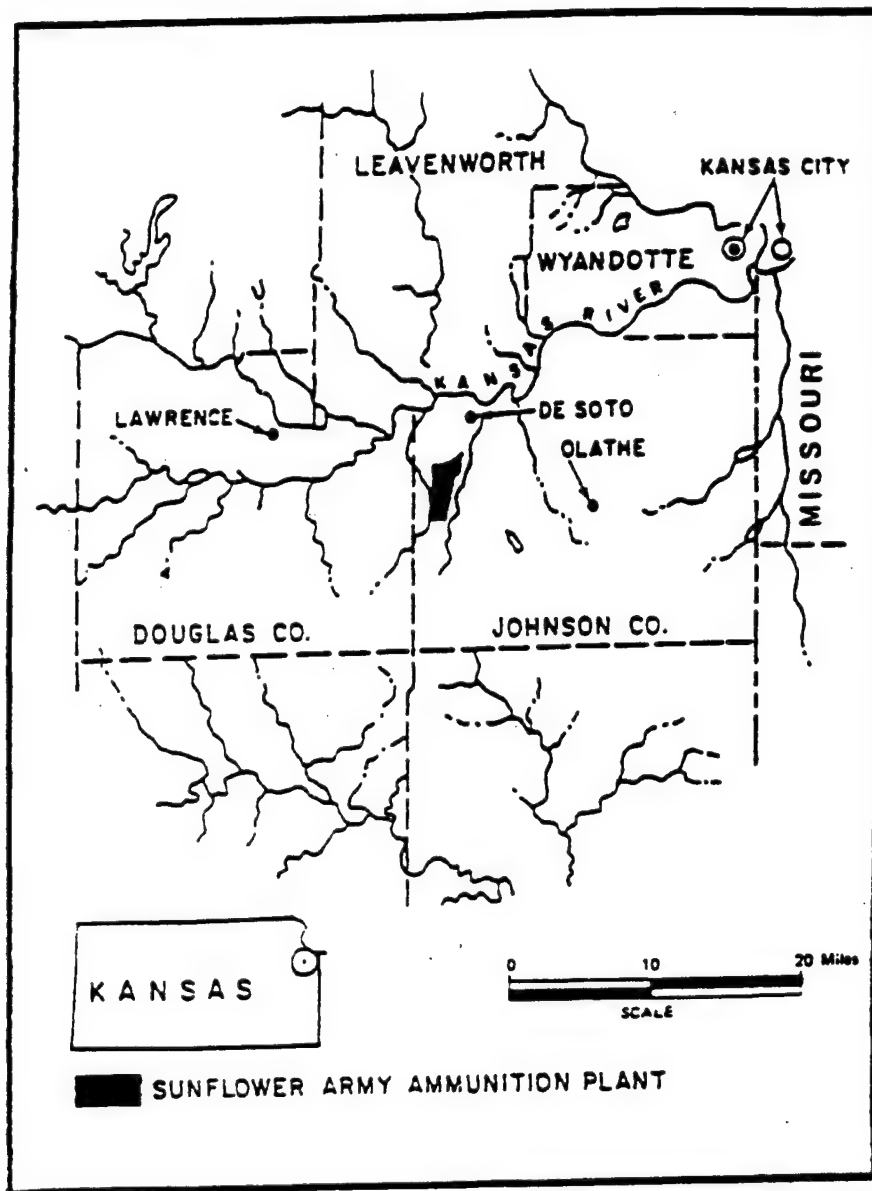
<b>Position</b>	<b>Name</b>	<b>Phone Number(s)</b>
Project Manager	Rick Almond	(205) 386-3030
Site Manager (Phase I) <sup>1</sup>	Alice Baker	(205) 386-2646
Safety Director (Phase I) <sup>1</sup>	Alice Baker	(205) 386-2646
Site Manager (Phase II) <sup>1,2</sup>	To Be Designated	To Be Designated
Safety Director (Phase II) <sup>1,2</sup>	To Be Designated	To Be Designated

<sup>1</sup> Phase I consists of the sampling phase. Phase II consists of the soil excavation phase.

<sup>2</sup> Phase II site manager and safety director will be designated at a later date.

### 3.0 MAPS OF WORK AREAS

Figure 1 shows the location of the Sunflower AAP within the state of Kansas. Sampling/excavation will be occurring in Cells 1 and 7 (SWMU 22/32) of the old explosives burning ground, Figure 2.



**Figure 1 : Location of the Sunflower AAP within the sate of Kansas**

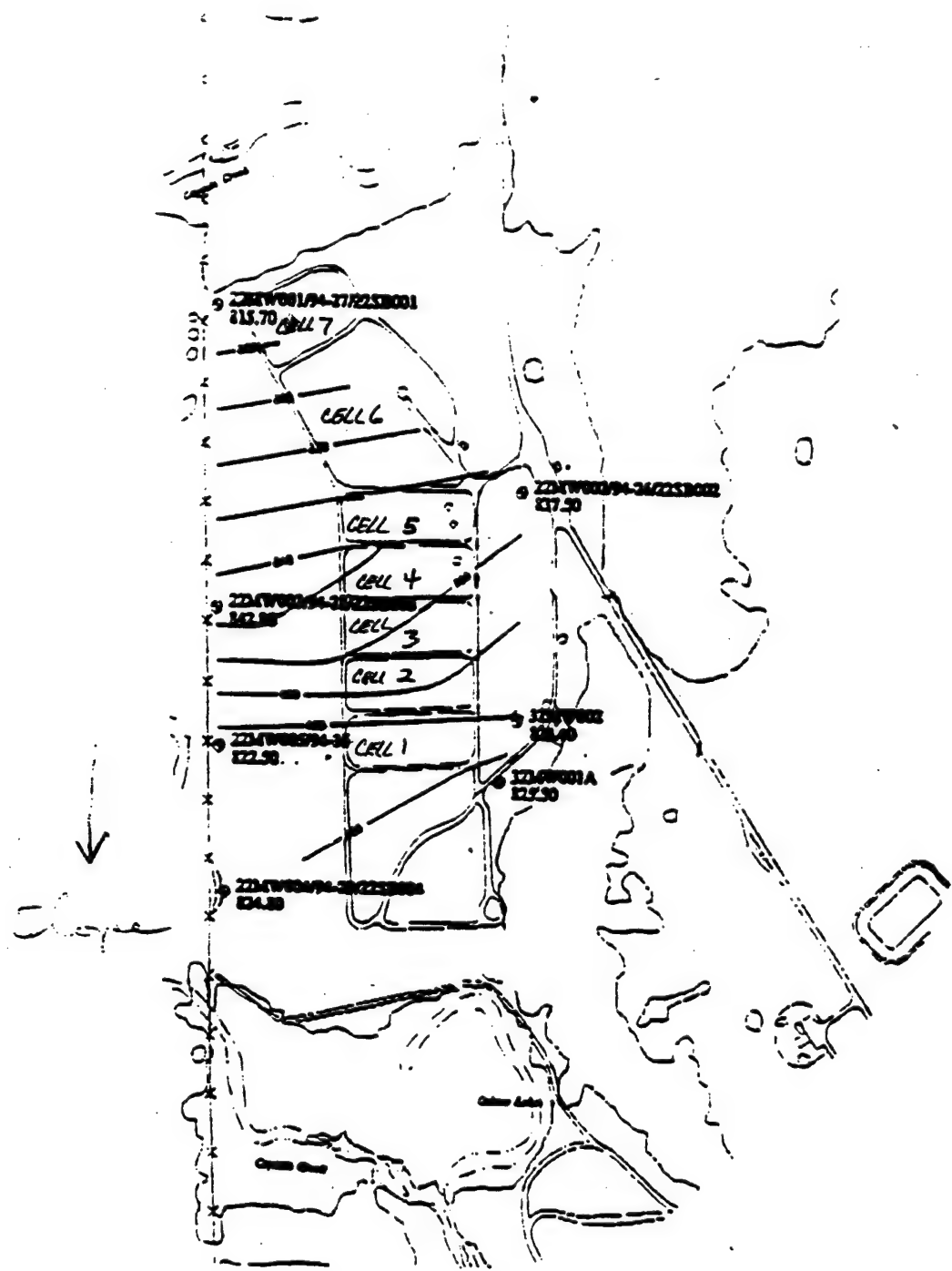


Figure 2 : Location of Old Burning Ground (Cells 1-7)

#### **4.0 PERSONNEL PROTECTIVE CLOTHING AND EQUIPMENT**

##### **4.1 GENERAL**

A two phase sampling / excavation program is being undertaken in support of a scientific study of phytoremediation of lead to be conducted at TVAE's Environmental Research Center in Muscle Shoals, AL. Phase I consists of soil sampling program. During Phase I a 90 X 90 foot grid will be established at two sites (one in Cell # 1 and one in Cell # 7) and approximately 144 soil samples will be obtained from the interior of the grids using an hand held soil probe. These samples will be analyzed for soil type, degree of heavy metals contamination, and location of heavy metals. During phase II hand tools will be used to excavate approximately two yards of soil, to depth of about 1 foot. The excavated soil will then be packaged (drummed) and shipped to TVAE's facility for use in the study.

In implementing sampling / excavation program, the Sunflower Army Ammunition Plant Accident Prevention Program, the Corps or Engineers Safety Requirements, and the TVA Environmental Research Center's Chemical Hygiene Plan (Attachment 14.1) will, as a minimum, serve as TVA's personnel protective clothing and equipment guide. All protective clothing and equipment must meet the minimum standards prescribed by ANSI, OSHA, and TVA.

##### **4.2 RESPONSIBILITIES**

The TVA site manager will have overall responsibility to ensure that all TVA personnel utilize the protective clothing and equipment prescribed. Each individual shall be familiar with the necessary clothing and equipment to do their job and shall keep all items serviceable at all times.

Any faulty equipment shall be reported to the appropriate TVA personnel for repairs and or replacement. TVA personnel shall not attempt to repair any equipment other than that belonging to the TVA.

#### **4.3 SAMPLING ACTIVITIES**

Sampling activities will involve the collection of soil at the old explosive burning grounds on the SFAAP. Risks associated with these activities include:

- Moderate risk of encountering explosive material, or materials associated with explosives manufacturing, and/or degradation products of explosive materials when sampling/digging.
- Moderate risk of accidental ingestion of heavy metals contaminated soil.
- Moderate risk of fall and trip hazards.
- Moderate risk of back injury/strains from lifting heavy objects.
- Moderate risk of pinches, scrapes, cuts, and abrasions.
- Moderate risk exists from hazards associated with heat stress (heat cramps, heat exhaustion, heat stroke) and hypothermia.
- Moderate risk of inhalation from dust hazards.
- Low to moderate risk of contact with poisonous or disease bearing plants and animals (i.e. poison ivy, poison oak, snakes, spiders, disease bearing animals, etc. ).
- Low to moderate risk of contact with bearing insects such as mosquitoes, ticks, bees, wasps, hornets, chiggers, etc.

The samples obtained will consist of lead contaminated soil. Therefore, prudent handling and decontamination procedures will be followed (see section 4.9) to insure against accidental ingestion. Sample collection will be achieved by walking to the sampling site and obtaining the sample by digging the soil with hand tools.

The SFAAP is endemic for Hanta virus. The virus is usually encountered by disturbing rodent nests soiled with dried rodent fecal and urine. Therefore site personnel will avoid disturbing rodent nests.

#### **4.4 PROTECTIVE CLOTHING AND EQUIPMENT**

Level D modified, will be used during all operations involving the sampling or excavation of soil. Transportation and storage activities associated with the sampling/excavation will be conducted using personnel protection level D. A listing of the safety equipment required for

these levels is provided in Table 1. These levels of protection may be modified by the Health and Safety Officer.

Due to the potential for skin and/or inhalation exposure to lead contaminated dust, workers will wet down all areas in which dust may be a factor. At a minimum this will include wetting down areas in which soil sampling or excavation is occurring. A presence of visible dust emission will be a criterion upon which protection equipment upgrades or dust suppression measures will be implemented.

TVA will provide appropriate gloves, safety goggles, safety shoes, coveralls, and respiratory protection equipment.

#### **4.5    SAFETY GLASSES**

TVA will provide all TVA personnel with safety glasses or goggles as appropriate to the situation. TVA personnel requiring prescription glasses shall be provided prescription safety glasses by TVA. Contact lenses will not be worn on-site.

#### **4.6    HARD HATS**

TVA personnel will be issued TVA hard hats and will be worn in hard hat designated areas. The exclusion zone at sampling/excavation sites will be considered a hard hat area.

#### **4.7    SITE CONTAMINATION**

The soil at the excavation sites is contaminated with lead. TVA will utilize site controls to assure that the contamination is not spread.

**Table 1**  
**Protective Clothing and Equipment Required for**  
**Level D, and Level D-Modified**  
**Personnel Protection**

**Level D Equipment (For use when skin contact is unlikely)**

Other than ordinary requirements for hard hat, safety glasses, and safety boots; no special safety equipment is required.

**Level D-Modified Personnel Protection (For use when skin contact is likely)**

Personal protective equipment for Level D-modified consist of:

- One-piece chemical-resistant tyvek coveralls.
- Half Mask Respirator with HEPA (high efficiency particulate) type canisters.
- Hard Hat.
- Steel toe and shank over the sock boots or leather steel toe/shank safety boot with disposable boot covers.
- Tape between shirt sleeves and inner glove.
- Tape between pants cuff and boots.
- Inner surgical and outer chemically protective gloves.
- Outer work gloves (as needed).

## 4.8 SITE CONTROLS

### **General Information**

Prior to engaging in the sampling/excavation activities, TVA will establish site controls. The primary purpose for site controls is to provide a controlled environment in which the lead contaminated soil can be safely handled. A secondary, but equally important goal is to prevent the spread of contaminants beyond areas currently contaminated. These controls will consist of a designation of work areas (or zones) for soil sample collection/excavation, and a work zone for decontamination of equipment and personnel. The work area will be subdivided into three distinct work zones. These are the:

- **Exclusion Zone** - This the area of greatest contamination and presents the highest potential for worker exposure to hazardous conditions. The exclusion zone includes all active work areas.
- **Contamination Reduction Zone** - This area serves as a transition area between the exclusion zone and the support zone. Personnel and equipment decontamination facilities will be located in the contamination reduction zone.
- **Support Zone** - The support zone serves as a clean control area. This area consists of all areas beyond the exclusion and contamination reduction zones.

Where possible, existing work zones will be used. If work zones have been not designated, or are currently not designated, then these zones will be designated prior to working at the site. The most likely area to be designated as the exclusion zone will any areas currently designated as solid waste management units (SWMU) or the area immediately surrounding the area where sample collection or soil excavation will occur - whichever is the larger. In designating the work zones, TVA will take into consideration the need to: prevent the spread of contaminants, minimize work area size, and operate safely. Movement within the exclusion and contamination reduction zones will be restricted to personnel directly involved in:

- Obtaining samples
- Evacuating soil

Access to the exclusion and contamination reduction zones will be restricted by the use of access restriction tape and signs indicating that access to the work area is restricted.

### Exclusion Zones

Exclusion zones are those areas with the highest potential for accidental explosion or exposure to hazardous chemicals exists. Soil sampling and soil excavation will take place in the exclusion zone. Personnel entering or exiting this zone will do so from the contamination reduction zone.

At a minimum, Level D personal protective equipment will be required in the exclusion zone. When sampling or excavation activities are ongoing the minimum level of protection required will be Level D Modified. In addition, when soil sampling or excavation activities are occurring, the soil surrounding the sampling/excavation site will be sprayed with water, using a hand held garden type sprayer, as a dust prevention measure.

Vehicles will not be present during Phase I but may be utilized in Phase II to pickup drums of contaminated dirt. No vehicle will be allowed in exclusion zone unless the ground is dry and free of mud. Any vehicles used in the exclusion zone will be decontaminated in the contamination reduction zone by rinsing the tires and underside of the vehicle with water using a hand type garden sprayer.

The exclusion zone will be marked off by barricades (physical barriers to include containment structure walls or banner tape), which will be placed at a recommended minimum 30 feet from the edge of active operations. All personnel entering or leaving the exclusion zone will sign a log indicating entrance and exit times.

Visitors will not be permitted into the exclusion zones without the approval of the Health and Safety Officer. No one will be admitted into the exclusion zone without having met the requirements for employee training outlined in Section 5.2.

The exclusion zone will be clearly posted around the perimeter with appropriate signs. When possible, personnel in this zone will work in a team (minimum of two people) and remain in visual or audible contact with personnel outside the exclusion zone.

#### Contamination Reduction Zone

The contamination reduction zone consists of a designated cleanup area. Included in this zone will be all field equipment and supplies to be used in the exclusion zone.

No one will be admitted into the contamination reduction zone without having met the requirements for employee training outlined in Section 5.2.

Vehicles will not be utilized during Phase I; but, may be utilized in Phase II to pickup drums of contaminated dirt. Any vehicles used in the exclusion zone will be decontaminated in the contamination reduction zone by rinsing the tires and underside of the vehicle with water using a hand type garden sprayer.

#### Support Zone

The support zone includes all areas outside the exclusion and cleanup zones. The exposure potential in these zones is minimal.

Protective equipment worn in the exclusion zone will not be worn in the support zone, except during emergencies.

### **4.9 DECONTAMINATION MEASURES**

#### General Comments

The primary hygiene concern is the presence of lead contaminated soil. The primary decontamination procedure personnel will undergo is protective equipment removal and the rinsing of hands prior to leaving the designated work area. Contaminated clothing will be secured in drums and disposed of as a hazardous material.

The Health and Safety Officer (HSO) will be responsible for decontamination activities. Where applicable, site personnel will be instructed in the proper decontamination procedures. All personnel will review the site and familiarize themselves with the location of all necessary equipment.

The personnel and equipment decontamination procedures discussed here are designed for anticipated conditions and may be modified in response to unforeseen site conditions or other safety considerations.

#### Personal Hygiene/Decontamination

All personnel will be made aware of any personal habit (i.e. facial hair, smoking, putting fingers in mouth) that may allow contaminants into or onto body. All personnel will check that the regularly worn Personnel Protection Equipment (PPE) is clean and in good condition. (e.g., hard hats and liners, eye protection, etc.). Torn or damaged protective clothing will be replaced immediately after appropriate personnel decontamination.

All personnel are subject to decontamination procedures when exiting the exclusion zone. Decontamination procedures will be conducted in the contamination reduction zone located outside the exclusion zone. No PPE will be removed from the exclusion zone without first being subjected to proper decontamination or disposal procedures. PPE (including booties, gloves, and tyvek coveralls) will be routinely collected and drummed for proper disposal.

Detailed decontamination procedures for Level D and Level D (Modified) are provided in Table 2. The decontamination procedures described are conservative and subject to modification based on the potential for contamination.

**Table 2**  
**Procedures for Level D and Level D-Modified Type Personnel Protection**

**Level D Personnel Protection**

No personnel protection equipment or decontamination procedures required.

**Level D-Modified Personnel Protection**

**A. Equipment Worn - Level D**

See Table A-1.

**B. Procedure for Full Decontamination - Level D**

**Station 1: Segregated Equipment Drop**

Deposit equipment used on-site (tools, sampling devices, and containers, monitoring instruments, radios, clipboards, etc.) on decontamination pad (plastic barrier) for decontamination by TVA personnel. After decontamination, all tools are stored in the exclusion zone. Any tools or equipment required to leave the exclusion zone are to be inspected by the HSO or an appointed assistant.

Equipment needed:

- Various sized containers.

**Station 2: Safety Boot Wash and Rinse**

Thoroughly wash safety boots. Scrub with long-handle, soft-bristle scrub brush and copious amounts of water. Repeat, as many times as necessary.

Equipment needed:

- Container (5-10 gallons)
- Rinse Water
- Long-handle soft -bristle scrub brushes

## Table 2 (Cont)

### Procedures for Level D and Level D-Modified Type Personnel Protection

#### Station 3: Tape removal, Boot removal, Boot Drop, and Outer Glove Removal (Outer glove, if used)

Remove tape around boots and gloves and deposit in container with plastic liner. Remove outer gloves and dispose of in container with plastic liner.

Equipment:

- Container (20-50 gallons)
- Plastic Liners

#### Station 4: Tyvek Coverall Removal

Remove Tyvek Coverall. Deposit in container with plastic liner.

Equipment:

- Container (30-50 gallons)

#### Station 5: Respirator Removal

Remove respirator. Avoid touching face with gloves. Deposit canisters to a plastic lined container. Check respirator to ensure proper function and cleanliness.

Equipment:

- Container (30-50 gallons)
- Plastic liner

#### Station 6: Inner Glove Removal

Remove inner gloves (if used) and deposit in container with plastic liner.

Equipment:

- Container (30-50 gallons)
- Plastic liner

**Table 2 (Cont)**

**Procedures for Level D and Level D-Modified Type Personnel Protection**

Station 7: Hand washing

Decontamination will be achieved by a rinsing of the hands three times with soap and water via the use of a common garden type hand sprayer.

Equipment:

- Bar of Soap
- One garden type hand sprayer

### Equipment Cleanup

All equipment that has been in the exclusion or cleanup zones will be evaluated to assess the need for decontamination prior to removal from the job site. Equipment requiring off-site maintenance will be inspected for possible contamination and, if necessary, decontaminated prior to release for maintenance.

Sensitive instrumentation will be handled in a manner that will minimize the potential of exposure to hazardous materials.

Hand tools and equipment exposed to potential contaminants will be wash or wiped clean, depending on the type of equipment (i.e., high pressure, low volume water, brush and low phosphate detergent, cleaning towels or rags, etc.)

## **5.0 TRAINING**

### **5.1 GENERAL**

TVA personnel involved in the field work at SFAAP shall be trained by personnel at SFAAP as per SFAAP's minimum safety and security requirements for contractors (Attachment 14.2).

### **5.2 TRAINING REQUIERMENTS FOR PERSONNEL ENTERING SWMU'S**

All on-site personnel to enter a solid waste management unit (SWMU), or designated exclusion zone, are required to have participated in a 40-hour comprehensive training course that complies with OSHA 29 CFR 1910.120.

The site manager must have at least eight (8) additional hours of specialized training pertaining to hazardous waste site management meeting the requirement of OSHA 29 CFR 1920.120.

Site personnel having participated in the training described above are required to have participated in a minimum of eight hours of refresher training meeting OSHA 29 CFR 1920.120 requirements on an annual basis following completion of the comprehensive training requirements described above.

### **5.3 ON-SITE TRAINING**

Upon arrival at SFAAP, in conjunction with in-processing and set-up, TVA personnel shall receive site specific training and orientation as deemed necessary by SFAAP / USAEC / USACE / TVA.

All pertinent subjects shall be covered to include but not necessarily limited to:

- Site security
- Site safety precautions/regulations
- Site warning signals
- Site orientation and facility locations

- Site specific rules and regulations
- Severe weather warnings/conditions/actions
- Emergency response actions

## **6.0 MEDICAL PROTOCOL**

### **6.1 KEY MEDICAL PERSONNEL**

Key medical personnel necessary to support any emergencies will be the emergency medical technicians (EMT) provided by the SFAAP fire department. In the event of an accident or illness beyond the scope of SFAAP on-site facilities, the Shawnee Mission Medical Center will be used. During all emergencies, SFAAP emergency services staff (fire/ambulance) will be the first point of contact (extension 3333).

Figure 3 illustrates the route from SFAAP to Shawnee Mission Medical Center. The hospital is within 35 minutes of the site. To access the Shawnee Mission Medical Center (SMMC), travel out the main gate to 135th street and turn right (east). Travel 2 miles to K-10 and drive east on K-10 to I-435. Travel east on I-435 to I-35. Travel North on I-35 to 75th street and exit to the SMMC.

TVA's site manager will coordinate all field activities (through SFAAP's staff) with the emergency medical facilities at SFAAP. This will ensure appropriate medical coverage and support is always available in the event a medical emergency occurs.

### **6.2 EMERGENCY PHONE NUMBERS**

Key emergency telephone numbers are provided in Table 3.

### **6.3 EMERGENCY RESPONSE EQUIPMENT**

The Sunflower Army Ammunition Plant fire department will provide emergency response equipment and personnel within the SFAAP boundary. All TVA personnel will adhere to the SFAAP/TVA standard operating procedures for emergency response. Emergency response actions and responsibilities will be included in the initial briefing received by TVA upon arrival at SFAAP.

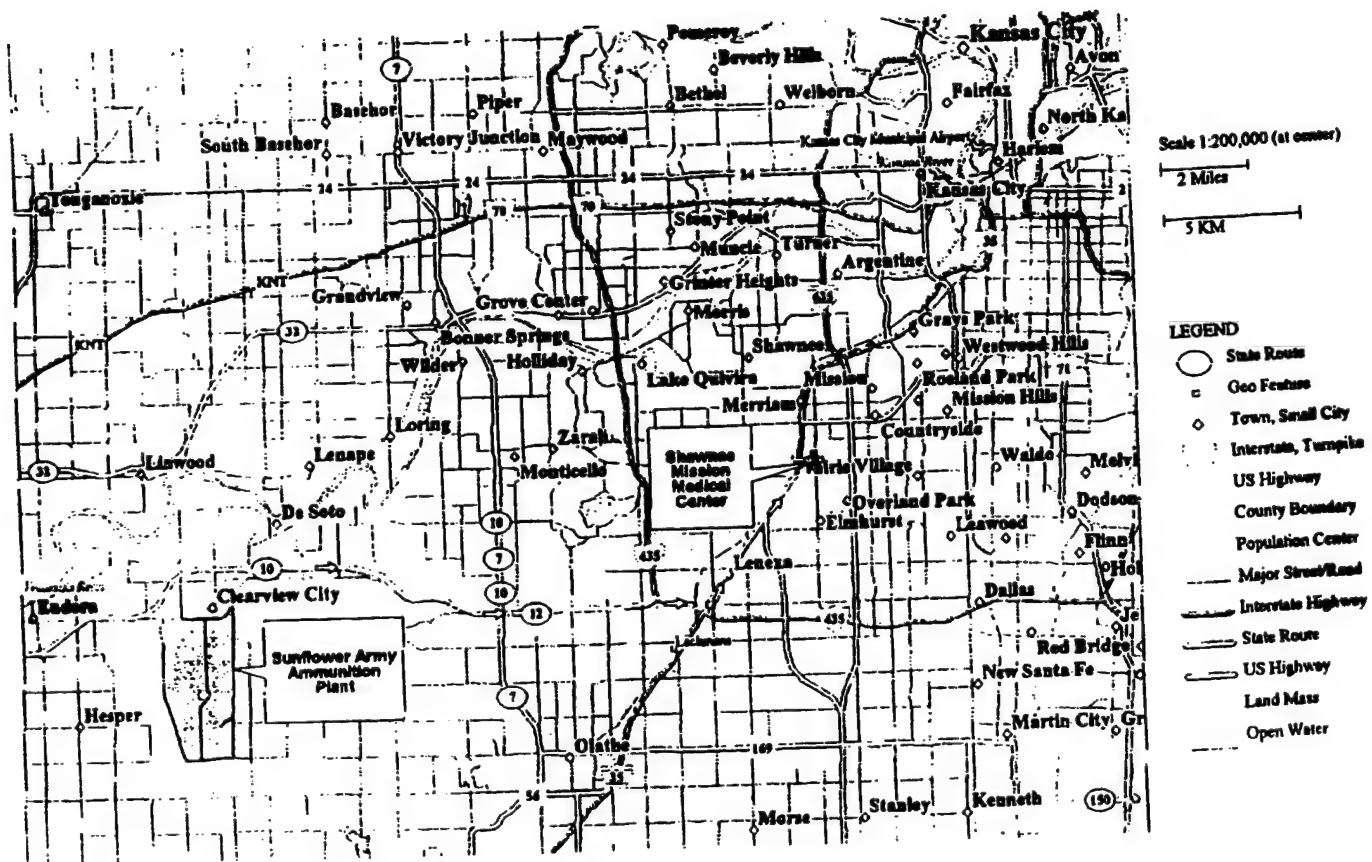


Figure 3 – Highway Route from SFAAP to Hospital in Sunflower, Kansas

**Table 3 - Emergency Telephone Numbers**

Service	Number
<b>Medical Emergency</b>	
Ambulance: SFAAP on-site	ext. 3333
Ambulance: Johnson County Dispatch	(913) 676-2000
Hospital: Sunflower Hospital (Bldg. 205)	(913) 791-6794
Hospital: Shawnee Mission Medical Center	(913) 676-2000
Poison Control Center	(212) 764-7667
<b>Fire</b>	
Fire: SFAAP on-site	ext. 3333
Fire: Johnson County Dispatch	(913) 676-2000
<b>Police</b>	
Police: SFAAP	ext. 3300
<b>Environmental</b>	
Chemical Transportation Emergency Center (CHEM-TREC)	(800) 424-9300
Environmental Protection Agency (Region VII)	236-3778
Environmental Response Team Spill Control: Johnson County Dispatch	(913) 676-2000
Johnson County Emergency Operations Center (EOC) OLATHE	791-5912 FAX 791-5002
National Response Center	(800) 424-8802
State Emergency Response Commission (Kansas)	296-1690
<b>Safety</b>	
Safety Office: SFAAP	ext. 6788
Suspected Explosives: Army ACO Staff	ext. 6789
NIOSH: Health Hazard Evaluation	(513) 684-4382
OSHA: Technical Data Center	(202) 523-9700

#### **6.4 FIRST AID PROCEDURES**

All TVA employees are familiar with first aid procedures. A first aid instructional manual for TVA employees is provided in Attachment 14.3. TVA field personnel have been trained in CPR techniques.

TVA's site manager will coordinate any additional training or first aid-related subjects with the safety office at SFAAP. This will be handled with assistance from the Safety Officer at SFAAP.

#### **6.5 DISCOVERY OF EXPLOSIVES**

In any situation where explosives are identified or suspected, all work at the site will cease, the area evacuated, and the appropriate SFAAP staff contacted (see telephone number for Army Administrative Contracts Officer (ACO) staff in Table 3). Work shall not proceed at the site until the area has been cleared by an EOD team.

## **7.0 PERSONAL HYGIENE**

### **7.1 PERSONAL HABITS**

Eating, drinking, chewing, and smoking will be prohibited within the exclusion and contamination reduction zones. Only areas designated for that purpose will be used. Personnel will be required to wash their hands prior to eating and anytime contact with contaminated materials is suspected.

Smoking materials such as cigarettes, cigars, pipes, matches, lighters, etc., will not be permitted in the exclusion and contamination reduction zones. All such items will be left in the areas designated by SFAAP and not carried on the person.

### **7.2 MEDICAL SURVEILLANCE**

All personnel involved in on-site operations must participate in an ongoing medical surveillance program meeting the requirements of OSHA 29 CFR 1920.120 and ANSI Z-88.2 before working at the site. The medical surveillance protocols and examination results are overseen by a licensed physician who is certified in Occupational Medicine by the American Board of Preventive Medicine, or who, by necessary training and experience, is Board-eligible.

#### **7.2.1 MEDICAL EXAMINATIONS**

In consultation with the occupational physician, and based upon probable site conditions, potential occupations exposures and required protective equipment, the minimum content and frequencies of required medical examinations are as follows:

**Initial Examination** (preliminary to employment) - Determines complete medical history and minimum physical requirements. Tests include vision, hearing, smell, speech, drug screening and urinalysis.

**Baseline Physical** - Performed prior to potential exposure to hazardous/toxic substances. The baseline examination will establish data to subsequently verify the efficacy of protective measures and to later determine if exposures have adversely affected the worker. The standard biomedical

monitoring performed includes a full physical, EKG, chest X-ray, hematology evaluation (including complete blood count, differential and platelet count, hemoglobin and hematocrit, urinalysis, vision screen, executive profile (SMA-22, CBC, thyroid profile), pulmonary function test, audiometry, and proctoscopic examination (at the physician's discretion for males).

**Annual Examination** - Same as Baseline Physical, with the exception that the EKG, chest X-ray, and proctoscopic examination (male personnel only) are performed at the discretion of the examining physician.

**Special Medical Surveillance Parameters** - Additional examinations and tests may be performed following exposure to hazardous substances, or if deemed necessary by the examining physician, as indicated by the medical history and/or initial examination results. The evaluation will be repeated as indicated by substandard performance or evidence of particular stress evidence by injury or time loss due to injury by the worker.

**Final Examination** - A final examination will be performed for any employee terminating employment.

#### **7.2.2 MEDICAL SURVEILLANCE RECORDS**

Records certifying the participation of the worker in the medical surveillance program, the date of the last examination, and name of reviewing occupation physician will be maintained in each employee's. The written medical opinion from the attending physician as to fitness for site work and wearing respiratory protection is maintained in the employee's file and will be made available upon request for any TVAE employee. Subcontractor personnel will be required to supply fitness for work certification prior to work on the site.

#### **7.2.3 FITNESS FOR WORK CERTIFICATION**

At a minimum, each person who wears respiratory protection must meet the requirements of 29 CFR 1910.134. A certification in each employee's file from the examining physician is required stating the person is "fit for duty" to wear the required PPE, including air-purifying respirators or SCBA, and perform the required work.

### 7.3 AIR MONITORING

Air monitoring will not be implemented during the sampling (during phase I). Monitoring will not occur in this phase due to: the limited amount of time personnel will be within the exclusion zone; the extent protective equipment currently specified; and an the limited amount of lead born dust expected to be produced as a consequence of soil disturbance. Expected soil disturbance during phase I consists of the establishment of a grid 90 X 90 foot grid system, soil sampling with a hand held soil probe, and placement of soil cores in plastic bags. All activities will be conducted using dust suppression methods as outline in Sections 4.4 and 4.8.

Air monitoring will be implemented during the excavation phase (phase II). Expected soil disturbance during phase II will consist for the digging up of approximately two yards of soil with hand tools. Air monitoring will consist of A personnel air monitoring pump utilizing a mixed cellulose acetate type air filter. Each person within the exclusion zone will wear a personnel air monitor. All activities will be conducted using dust suppression methods as outline in Sections 4.4 and 4.8.

## **8.0 PERSONNEL REQUIREMENTS**

The TVA project management team will consist of the following:

- 1 - Project Manager
- Others - As required

The TVA field team will consist of the following:

- 1 - Site Manager
- Professionals (SD and SC) - As required
- Engineering Aides (SE) - As required
- Operators - As required

## **9.0 VISITOR POLICY**

All visitors to SFAAP will be required to sign in through the SFAAP security office to obtain a visitor's badge and vehicle pass.

Visitors will be permitted within the exclusion and contamination reduction zones, only with the approval of both TVA's Health and Safety Officer (HSO) and TVA's site manager. All site visitors entering these restricted zones will be briefed on the appropriate section of this Health and Safety plan deemed necessary by the HSO. Visitor vehicles are restricted to the support zone.

Unauthorized persons found in the exclusion zones will be escorted out of the exclusion zone and be subject to any applicable decontamination procedures. If the unauthorized person(s) do not respond to action taken by the site personnel (i.e. being escorted out of the restricted zone) the TVA site manager or the on-site Contracting Officer's Representative will contact the SFAAP police.

#### **10.0 SUPPORT FROM SFAAP AND TVA**

SFAAP maintains qualified and trained Emergency Medical Technicians (EMT), fire fighting personnel, environmental officers, and safety officers on-site. EMTs and fire fighting personnel are on duty 24 hours per day. SFAAP EMTs will provide response to emergencies and transportation to designated local hospitals.

SFAAP's Administrative Contracts Officer will serve as TVA's point of contact with TVA as well as the initial contact for assistance for other SFAAP offices (i.e., medical, environmental, safety, and fire).

## **11.0 EMERGENCY CONTINGENCY PLAN/ACCIDENT REPORTING**

### **11.1 EMERGENCIES**

Should events, incidents, or accidents occur beyond the scope of this plan, TVA personnel will take direction from TVA, USACE, USAEC, or SFAAP to evacuate the plant site to a safe location as designated. Return to normal duties will follow an "all clear" notification from SFAAP.

### **11.2 ACCIDENTS AND REPORTS**

Accidents resulting in a fatality, lost-time injury or illness, hospitalization of three (3) or more personnel, or property damage to government or contractor property (which occurred during the performance of the contract) equal to or exceeding \$2,000.00 must be telephonically reported to the U.S. Army Environmental Center (USAEC), SFIM-AEC-TSS, phone number (410) 671-4811, as soon as possible, but not later than two (2) hours after occurrence and reported in writing within five (5) days of occurrence on DA Form 285 (Attachment 14.4). Additional forms may be obtained from the SFAAP Safety Office. The above procedure is designed to meet OSHA regulations requiring notification of fatalities or hospitalization of three or more personnel within 8 hours of learning of the accident either verbally or by written communication. All other accidents/incidents must be telephonically reported to USAEC, SFIM-AEC-TSS, phone number (410) 671-4811, within eight (8) hours of occurrence.

Accidents will also be reported using TVA protocol and procedure (Attachment 14.5, TVA Safety Program - Management Practice/Serious Accident Investigation, Procedure Number TVA/DASHO/STD/ALL/X.X) through TVA's chain of command and using the appropriate TVA forms and instructions. Accident reporting forms include:

- Form CA-1 Federal Employee's Notice of Injury (Job Related) – Attachment 14.6
- TVA 91 79 Claim of Disability (Job Related) – Attachment 14.7
- TVA 255 TVA Report of Vehicle Accident, Theft, or Fire – Attachment 14.8
- SR 13 Alabama Department of Public Safety (Private Vehicle) – Attachment 14.9

## **12.0 SECURITY**

### **12.1 GENERAL**

The facilities and equipment at Sunflower Army Ammunition Plant, Sunflower, Kansas, as well as the plans, methodologies, and literature contained in this document, are "unclassified" concerning national security. Security, as it relates to personnel-allowed access to buildings, will be imposed to control personnel at the test site. SFAAP security personnel will control the public's access to SFAAP.

### **12.2 SITE CONTROL MEASURES**

SFAAP security will control access to all sites within the plant area.

### **12.3 BADGES**

TVA personnel will be issued permanent non-escorted identification badges upon arrival at SFAAP. These badges will be issued in accordance with normal and routine SFAAP security procedures and all badges will be surrendered to SFAAP security department upon completion of the field activities.

### **12.4 VEHICLES**

TVA's vehicles, whether U.S. Government vehicles or rental units, will be allowed at SFAAP according to normal security SOP (standard operating procedure). TVA vehicles will be subject to all governing rules and regulation enforceable at the time the test plan is executed.

### **12.5 CAMERAS**

All TVA personnel will be required to register cameras with SFAAP's security department upon arrival. A camera pass will be required for each camera carried on-site.

**12.6**     **ACCESS**

TVA's site manager will control access to the SWMU's in coordination and cooperation with SFAAP/TVA. However, security for this operation will be under the direct supervision of SFAAP security personnel in strict compliance with all enforced procedures and regulations.

**12.7**     **FIREARMS**

TVA personnel will not be allowed to carry firearms on SFAAP.

**13.0****SIGNATURES**

All TVA personnel related to the sampling/excavation project will read this health and safety plan and sign the form in Attachment 14.10 to certify they, the undersigned, have read this Health and Safety Plan, understand its contents, and will comply with all provisions contained herein. (This record will be kept on-site.)

14.0

ATTACHMENTS

14.1

**ATTACHMENT: 1996 Chemical Hygiene Plan, for the Environmental Research Center**

May 31, 1996

Center Employees

**CHEMICAL HYGIENE PLAN FOR THE CENTER**

The most recent revision of the Chemical Hygiene Plan for the Center is attached as is a copy of the text of Title 29 of the Code of Federal Regulations part 1910.1450. Please review this document and keep it in your files.

The plan was reviewed and revised by a team consisting of the Chemical Hygiene Officers: Liz Bailey, Sheryl Cannon, Tim Holt, Robert Johnson, and Bill Rogers. If you have questions about the document, its applicability, its interpretation, or implementation, please contact one of the Chemical Hygiene Officers.



William J. Rogers, CTR 1K-M

WJR:PJM

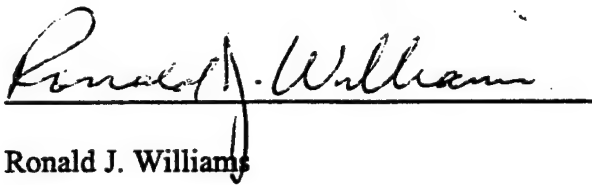
Attachments 

cc (Attachments):

Files, Center, CEB 1C-M

Chemical Hygiene Plan  
Environmental Research Center  
Revision 4  
May 31, 1996

Approved by:

A handwritten signature in cursive script, reading "Ronald J. Williams", is written over a horizontal line.

Ronald J. Williams  
Manager  
Environmental Research Center

## REVISION LOG

To take into account recommendations from "Agency-Level Health and Safety Program Evaluation Environmental Research Center FY 1996."

- A. Change "team leader" to "manager." Change "team" to "organization."
- B. Add paragraph 4.11.
- C. Eliminate references to a waste management plan since this requirement is met by another document.
- D. Modify 7.3 to require documentation of hood checks by memorandum and to require the use of checklists to ensure all hoods are identified and checked.
- E. To add the telephone number for Medical in 12.2
- F. To revise the instructions on spills in section 12.3.3 to specify when spill kits may be used and when the Hazard Response Team must be called
- G. To change "Public Safety" to "TVA Police"
- H. To update the Emergency Team Coordinator for the CEB

1.0 Purpose

1.1 This Chemical Hygiene Plan has been developed to set forth administrative procedures to meet the requirements of Title 29 of the Code of Federal Regulations (29CFR), Part 1910.1450.

1.2 The Chemical Hygiene Plan has as its goal to protect employees from health hazards associated with hazardous chemicals in the laboratory.

2.0 Scope

2.1 This Plan applies to work and work areas in the Environmental Research Center involving the laboratory use of hazardous chemicals as defined in 29CFR 1910.1450.

3.0 Definitions

3.1 The following terms are used in this Plan as defined in 29CFR 1910.1450:

Chemical hygiene plan, chemical hygiene officer, hazardous chemical, laboratory, laboratory-type hood, laboratory use of hazardous chemicals, medical consultation, physical hazard, reproductive toxins, select carcinogen.

3.2 OSHA - Occupational Safety and Health Administration

3.3 Action Levels - Action levels are specified in 29 CFR part 1910, Subpart Z, for certain chemicals. In their absence, OSHA permissible exposure limits (PEL's) are to be used. However, TVA has committed to a further set of exposure limits as specified in the TVA Occupational Health and Safety Standard Number 014, "Threshold Limit Values (TLV's)." References to "action levels" in this Plan refer to whichever of these limits is less.

3.4 TVA - Tennessee Valley Authority

4.0 Responsibilities

4.1 Managers who are responsible for work which meets the definition of "laboratory use of hazardous chemicals" shall be responsible for implementation of this Plan within their organization.

- 4.2 Each manager who is responsible for work which meets the definition of "laboratory use of hazardous chemicals" shall appoint a Chemical Hygiene Officer (CHO) who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of this Plan in that organization. Should other CHO's be needed at a lower level of organization, nothing in this Plan prohibits their appointment. See Attachment 1 for a current list of CHO's.
- 4.3 The Chemical Hygiene Officers shall provide technical guidance in the development and implementation of the Plan, shall serve as *ex officio* members of their organization's Chemical Hygiene Committees, and shall ensure adequate training is provided to ensure compliance with this Plan.
- 4.4 The CHO's shall ensure hood flows are measured annually as required by this Plan. The CHO's should ensure hoods are checked qualitatively on a quarterly basis.
- 4.5 The CHO's shall ensure all hazardous chemicals used in laboratory work are properly inventoried.
- 4.6 The CHO's shall ensure records required by this standard are retained for the proper period of time.
- 4.7 The CHO's shall meet annually to review the contents of this Plan and revise it as needed.
- 4.8 The Chemical Hygiene Committee (CHC) shall be made up of the organization's safety committee and the CHO. Should this committee lack expertise in problems of chemical hygiene, additional assistance may be requested as needed from the CHO's of other organizations or any other professional in TVA with suitable knowledge.
- 4.9 The CHC shall include the criteria of this Plan in its routine inspections.
- 4.10 The CHC shall review activities involving hazardous chemicals in category C (see below.) The results of these reviews shall be documented in writing. In these reviews, the CHC shall give particular attention to the following:
- Establishment of designated areas for use
  - Use of containment devices such as fume hoods or glove boxes
  - Procedures for safe removal of contaminated waste
  - Decontamination procedures.

- 4.11 Employees whose work falls under the Standard shall be given a copy of this Plan at least annually and shall maintain it for ready reference.

5.0 Chemical Inventory

- 5.1 A current, complete chemical inventory shall be maintained for the Center.

- 5.2 For the purposes of this Plan, chemicals in the laboratory are classified into three categories:

A. Materials with low toxicity, materials with physical hazards commonly encountered in laboratory work, those chemicals for which no protective equipment other than the routinely used gloves, safety glasses, and lab coats are required - this category may contain dilute solutions of chemicals in category B below.

B. Moderately-toxic materials, highly toxic materials, or materials with substantial physical hazard associated with their use. Those chemicals which must be used in a laboratory-type hood or with additional protective clothing such as aprons, goggles, face shields, blast shields, or special gloves.

C. Those chemicals which are described in 29CFR 1910.1450 as "select carcinogens," reproductive toxins, or substances which have a high degree of acute toxicity. (See 29CFR 1910.1200 Appendix A.)

6.0 Employee Protection/Standard Operating Procedures

- 6.1 Suitable engineering controls shall be provided to ensure employee protection.

- 6.2 The rules and requirements of the "Manual of Safe Work Practices," October 1990, Resource Development, Tennessee Valley Authority, shall be the standard operating procedures for safe work activities in work areas falling under the scope of this Plan.

6.3 Employee Exposure

- 6.3.1 For laboratory uses of substances which are regulated by OSHA, employees shall not be exposed to levels exceeding those specified in 29CFR part 1910, Subpart Z, or other levels adopted by TVA (see the definition of action level.)

- 6.3.2 If there is a reason to believe that exposure levels for any substance for which a standard requires monitoring routinely exceed OSHA or TVA action levels or TLV's, the CHC shall request that the exposure be measured.

6.3.3 If the initial monitoring prescribed by the paragraph above discloses employee exposure over the TVA or OSHA action level or TLV's, TVA shall immediately comply with the exposure-monitoring provisions of the relevant standard. Monitoring may be terminated in accordance with the relevant standard. Employees shall be notified in writing of monitoring results in accordance with 29CFR 1910.1450.

6.4 A Laboratory Emergency Plan is provided in Appendix I. It shall be used unless superseded by a more specific set of guidelines for any organization.

6.5 **Additional Requirements**

6.5.1 Chemicals in category B which produce fumes, vapors, or dust shall be used in a laboratory-type hood.

6.5.2 Those chemicals in category B which require the use of other appropriate protective equipment such as aprons, goggles, face shields, blast shields, or special gloves shall be used with the appropriate protective equipment.

6.5.3 Chemicals in category C shall not be used unless a review is performed and written approval of the use is made by the CHC. Use of these chemicals shall not be made unless appropriate control measures are in place and functioning to prevent employee exposure.

6.5.4 Chemicals in category C shall be required to be used in designated areas by the CHC where appropriate.

7.0 **Laboratory-type Hoods**

7.1 Laboratory-type hoods shall not be used unless they are functioning properly.

7.2 Laboratory-type hoods shall be inspected and tested annually by an industrial hygienist to ensure compliance with all appropriate federal guidelines. The results of this test and the guidelines to which the inspection was made shall be documented.

7.3 Quarterly, hoods should be checked qualitatively for flow. This check need only be performed in the three quarters in which the annual test was not performed. This test shall be documented by memorandum to files. CHO's should utilize a checklist to ensure all hoods in their area of responsibility are identified and checked.

7.4 Employees shall check laboratory-type hoods to ensure they are operating before using them.

8.0 Information and Training

8.1 Prior to assignment to a work area where hazardous chemicals are present or prior to assignments involving new exposure situations, employees shall be provided information apprising them of the hazards of chemicals present in the work area.

8.2 Employees shall be informed of:

The contents of 29CFR 1910.1450 and its appendices

The location and availability of this Plan

The permissible exposure limits for OSHA-regulated substances

Recommended exposure limits for other hazardous chemicals for which there is no applicable OSHA standard (see TVA OHS Standard 014.)

Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory.

The location and availability of known reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory - this includes but is not limited to Material Safety Data Sheets (MSDS) and a bookshelf in the Muscle Shoals Technical Library containing commonly-cited references.

8.3 Employees shall receive a copy of 29CFR 1910.1450 and its appendices.

8.4 Employee training shall include:

Methods and observations that may be used to detect the presence or release of a hazardous chemical such as visual appearance and odor

The physical hazards of chemicals in the work area

The health hazards of chemicals in the work area

Measures which shall be taken to protect employees from these hazards such as appropriate work practices, emergency procedures, and protective equipment

Applicable details of this Plan.

8.5 Training shall be documented. This documentation shall include attendance rosters, detailed outlines of training material, and results of any tests.

9.0 Medical Consultation and Examination

- 9.1 Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.
- 9.2 Where exposure monitoring reveals an exposure level routinely above the action level (or PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.
- 9.3 Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation for the purpose of determining the need for a medical examination.
- 9.4 All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee without loss of pay and at a reasonable time and place.
- 9.5 TVA shall provide the following information to the physician:
- The identity of the hazardous chemicals to which the employee may have been exposed
- A description of the conditions under which the exposure occurred including quantitative exposure data, if available
- A description of the signs and symptoms of exposure that the employee is experiencing.
- 9.6 For examinations or consultations required under the scope of 29CFR 1910.1450, the Tennessee Valley Authority shall be provided a written opinion from the examining physician which shall include recommendations for further medical follow-up, the results of the medical examination and any associated tests, any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical in the workplace, and a statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment. The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

10.0 Recordkeeping

10.1 Records of training, inspections, reviews, revisions to the Plan, and decisions of the CHC shall be kept for three years from the date the document was produced unless other recordkeeping requirements mandate a longer retention period.

10.2 Records of any measurements taken to monitor employee exposure and any medical consultations and examinations including tests or written opinions shall be kept for the duration of employment plus thirty years.

11.0 Annual Review

11.1 Annually, the various chemical hygiene officers shall meet to review the this Plan for effectiveness and update it as necessary.

## APPENDIX I

### Laboratory Emergency Plan

12.0 This appendix provides guidance for emergencies in laboratories. This section is not exhaustive and is not intended to cover every possibility, but rather is intended to give guidelines for the more commonly encountered emergency situations.

12.1 This appendix does not supersede any emergency procedures, rules, regulations, or administrative decisions promulgated by any other group within the Tennessee Valley Authority.

12.2 In various types of emergency, the building emergency team coordinator (see attachment 2), TVA Police (8911), Medical (2271), or the supervisor may need to be contacted. In any emergency, do not hesitate to call on any of these for assistance. Do not be concerned about correct protocol, rather obtain as much help as needed. Err on the side of getting too much help rather than too little.

#### 12.3 Evaluation and Evacuation

Any emergency situation such as a small spill, small fire, runaway reaction, personal injury, loss of power, loss of cooling water, or any other unforeseen circumstance shall be immediately evaluated by the persons present. If it cannot be handled without the chance of personal injury, evacuate and notify the building emergency team coordinator, TVA Police, and the supervisor of the work area. If there is potential for the emergency situation to endanger others, notify them and clear the work area.

If the situation is urgent, call loudly for help.

#### 12.3.1 Personal Injury

##### 12.3.1.1 Chemicals in the Eye

If chemicals get in the eye, go to the nearest eye wash station and flush the eyes with water, holding them open. Call loudly for help. While this is being done, someone else should contact Medical or TVA Police for further instructions. Continue flushing for at least 10 minutes or until instructed otherwise.

#### 12.3.1.2 Chemical Contact with Skin

If only small areas are involved such as the hands or forearms, wash with plenty of soap and water.

If chemicals are splashed on the body or clothing, flood the areas immediately with plenty of water. Use the nearest safety shower. Remove any clothing or shoes soaked with chemicals.

Water-reactive chemicals, of course, should not be flushed with water. Guidelines for handling such a situation should already be established. When in doubt, contact the supervisor or other knowledgeable person for instructions.

After washing, inspect the body, clothing, shoes, and jewelry immediately for lingering traces of the chemical. Do not replace clothing, shoes, or jewelry until it is certain all traces of the chemical are removed.

If a hazardous substance is involved, notify the supervisor.

#### 12.3.1.3 Minor Injury

Minor injury may be treated with the first aid kits. Notify the supervisor. The supervisor shall make an evaluation whether the employee must go to medical. If there is any doubt, escort the employee to Medical.

#### 12.3.1.4 Other Injury

Escort the injured employee to Medical and contact the supervisor. A trained person should apply first aid as necessary before going to Medical. If the employee is unable to walk or if there is any indication the injury is more than can be handled with minor first aid, contact both TVA Police and Medical for further instructions.

#### 12.3.1.5 Imminent Danger

Any person injured and unconscious shall not be moved by untrained personnel unless there is imminent danger of death.

#### 12.3.2 Fire

##### 12.3.2.1 Small Fires

Small fires may be handled by smothering them or using a fire extinguisher. Do not use water on flammable liquids. Contact the supervisor immediately as well as TVA Police.

#### 12.3.2.2 Other Fires

Evacuate and call TVA Police. Pull the nearest fire alarm lever.

#### 12.3.3 Spills

##### 12.3.3.1 Incidental Spills

Small quantities of material or larger quantities of dilute material may be cleaned up in the course of general work.

##### 12.3.3.2 Spills up to Five Liters

12.3.3.2.1 Spills of concentrated acids, concentrated bases, or organic solvents up to five liters may be cleaned up by volunteers utilizing commercially available spill kits provided the following restrictions are observed.

- a. If there is any doubt as to the capacity of the individual to handle the situation, the Hazard Response Team (see below) will be called.
- b. A half-mask respirator shall be worn for organic solvents, concentrated acids, and concentrated ammonia. The respirator must have cartridge corresponding to the chemical involved. An ammonia cartridge must be used for ammonia spills. General cartridges are usually suitable for other compounds. The individual wearing the respirator shall have been fit-tested and cleared with Medical (See the Center's Respiratory Protection Plan).
- c. No one shall work alone in cleaning up a spill.
- d. No one shall attempt to clean up a spill when toxic fumes are present in quantities too great to be handled by the half-mask respirators.

12.3.3.2.2 For chemicals which emit vapors, open windows and turn on fume hoods that are not already on. Contain the spill by using a spill kit corresponding to the material. Follow the directions on the spill kit. (Generally, spill kit instructions indicate making a dike around the spill with the absorbent and then filling in the middle, but instructions may vary from manufacturer to manufacturer.) Notify the supervisor.

If the spill is too large to be contained by the spill kit or if toxic fumes are present, evacuate the work area. Notify the building emergency team coordinator. Notify people in adjoining work areas. Notify the supervisor.

### 12.3.3.3 Spills Larger Than Five Liters

For spills larger than five liters or which cannot be handled by the instructions above, evacuate the work area. Notify the building emergency team coordinator. Notify people in adjoining work areas. Notify the supervisor. Notify the hazard response team as indicated on the most recent posting on a Safety Bulletin Board.

### 12.3.4 Other

Other situations such as power failures or loss of cooling water shall be handled by those involved. Adhere to the following guidelines.

12.3.4.1 When in doubt, evacuate. Notify the building emergency team coordinator as well as others in adjoining work areas.

12.3.4.2 Place a higher value on human life and safety than on equipment or buildings. Take no risks which might endanger any person to save a piece of equipment or a building.

12.3.4.3 Notify the responsible supervisor and TVA Police.

## ATTACHMENT 1

### Chemical Hygiene Officers

Land and Water Sciences  
Atmospheric Sciences  
Biotechnology  
Biotechnology  
Analytical Laboratory

Sheryl Cannon	(3078)
Liz Bailey	(3645)
Robert Johnson	(2654)
Tim Holt	(2044)
Bill Rogers	(3774)

## ATTACHMENT 2

### Building Emergency Team Coordinators

Environmental Research Center  
Chemical Engineering Building

Paul Enlow  
Ron Edwards

(3770)  
(2496)

END OF CHEMICAL HYGIENE PLAN

hazardous chemicals, they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures established by the employer. OSHA compliance officers will be talking to employees to determine if they have received training, if they know they are exposed to hazardous chemicals, and if they know where to obtain substance-specific information on labels and MSDSs.

The rule does not require employers to maintain records of employee training, but any employers choose to do so. This may help you monitor your own program to ensure that all employees are appropriately trained. If you already have a training program, you may simply have to supplement it with whatever additional information is required under the HCS. For example, construction employers that are already in compliance with the construction training standard (29 CFR 1926.21) will have little extra training to do.

An employer can provide employees information and training through whatever means are found appropriate and protective, though there would always have to be some training on-site (such as informing employees of the location and availability of a written program and MSDSs), employee training may be satisfied in part by general training about the requirements of the HCS and about chemical hazards on the job which is provided by, for example, trade associations, unions, colleges, and professional schools. In addition, previous training, education and experience of a worker may relieve the employer of some of the burdens of informing and training that worker. Regardless of the method relied upon, however, the employer is always ultimately responsible for ensuring that employees are adequately trained. If the compliance officer finds that a training is deficient, the employer will be cited for the deficiency regardless of who actually provided the training on behalf of an employer.

#### D. Other Requirements

In addition to these specific items, compliance officers will also be asking the following questions in assessing the adequacy of a program:

Does a list of the hazardous chemicals exist in each work area or at a central location?

Are methods the employer will use to inform employees of the hazards of non-routine tasks outlined?

Are employees informed of the hazards associated with chemicals contained in labeled pipes in their work areas?

On multi-employer workplaces, has the employer provided other employers with information about labeling systems and precautionary measures where the other em-

ployers have employees exposed to the initial employer's chemicals?

Is the written program made available to employees and their designated representatives?

If your program adequately addresses the means of communicating information to employees in your workplace, and provides answers to the basic questions outlined above, it will be found to be in compliance with the rule.

#### 5. Checklist for Compliance

The following checklist will help to ensure you are in compliance with the rule:

Obtain a copy of the rule. \_\_\_\_\_

Read and understand the requirements. \_\_\_\_\_

Assigned responsibility for tasks. \_\_\_\_\_

Prepared an inventory of chemicals. \_\_\_\_\_

Ensured containers are labeled. \_\_\_\_\_

Obtained MSDS for each chemical. \_\_\_\_\_

Prepared written program. \_\_\_\_\_

Made MSDSs available to workers. \_\_\_\_\_

Conducted training of workers. \_\_\_\_\_

Established procedures to maintain current program. \_\_\_\_\_

Established procedures to evaluate effectiveness. \_\_\_\_\_

#### 6. Further Assistance

If you have a question regarding compliance with the HCS, you should contact your local OSHA Area Office for assistance. In addition, each OSHA Regional Office has a Hazard and Communication Coordinator who can answer your questions. Free consultation services are also available to assist employers, and information regarding these services can be obtained through the Area and Regional offices as well.

The telephone number for the OSHA office closest to you should be listed in your local telephone directory. If you are not able to obtain this information, you may contact OSHA's Office of Information and Consumer Affairs at (202) 219-0151 for further assistance in identifying the appropriate contacts.

[59 FR 6170, Feb. 9, 1994, as amended at 59 FR 17478, Apr. 13, 1994; 59 FR 65948, Dec. 22, 1994]

#### §1910.1201 Retention of DOT markings, placards and labels.

(a) Any employer who receives a package of hazardous material which is required to be marked, labeled or placarded in accordance with the U. S. Department of Transportation's Hazardous Materials Regulations (49 CFR Parts 171 through 180) shall retain those markings, labels and placards on the package until the packaging is sufficiently cleaned of residue and purged

capors to remove any potential hazards.

(b) Any employer who receives a freight container, rail freight car, motor vehicle, or transport vehicle that is required to be marked or placarded in accordance with the Hazardous Materials Regulations shall retain those markings and placards on the freight container, rail freight car, motor vehicle or transport vehicle until the hazardous materials which require the marking or placarding are sufficiently removed to prevent any potential hazards.

(c) Markings, placards and labels shall be maintained in a manner that ensures that they are readily visible.

(d) For non-bulk packages which will not be reshipped, the provisions of this section are met if a label or other acceptable marking is affixed in accordance with the Hazard Communication Standard (29 CFR 1910.1200).

(e) For the purposes of this section, the term "hazardous material" and any other terms not defined in this section have the same definition as in the Hazardous Materials Regulations (49 CFR Parts 171 through 180).

[59 FR 37700, July 19, 1994]

#### §1910.1450 Occupational exposure to hazardous chemicals in laboratories.

(a) Scope and application. (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(iii) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated sub-

stance with exposure monitoring and medical surveillance requirements, paragraphs (d) and (e)(1)(ii) of this section shall apply.

(3) This section shall not apply to:

(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart Z, even if such use occurs in a laboratory.

(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(A) Procedures using chemically-immunoprecipitated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

#### (b) Definitions—

*Action level* means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

*Assistant Secretary* means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

*Carcinogen* (see *select carcinogen*).

*Chemical Hygiene Officer* means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

*Chemical Hygiene Plan* means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting

employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph e) of this section.

**Combustible liquid** means any liquid having a flashpoint at or above 100 °F (37.8 °C), but below 200 °F (93.3 °C), except any mixture having components with flashpoints of 200 °F (93.3 °C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

**Compressed gas** means:

- (i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 °F (21.1 °C); or
- (ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 °F (54.4 °C) regardless of the pressure at 70 °F (21.1 °C); or
- (iii) A liquid having a vapor pressure exceeding 40 psi at 100 °F (37.8 °C) as determined by ASTM D-323-72.

**Designated area** means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

**Emergency** means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

**Employee** means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

**Explosive** means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

**Flammable** means a chemical that falls into one of the following categories:

- (i) **Aerosol, flammable** means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;
- (ii) **Gas, flammable** means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) **Liquid, flammable** means any liquid having a flashpoint below 100 °F (37.8 °C), except any mixture having components with flashpoints of 100 °F (37.8 °C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) **Solid, flammable** means a solid, other than a blasting agent or explosive as defined in §1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

**Flashpoint** means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 66-79))—for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 °F (37.8 °C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79))—for liquids with a viscosity equal to or greater than 45 SUS at 100 °F (37.8 °C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setafash Closed Tester (see American National Standard Method of

that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

**Laboratory use of hazardous chemicals** means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

**Medical consultation** means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

**Organic peroxide** means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

**Oxidizer** means a chemical other than a blasting agent or explosive as defined in §1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

**Physical hazard** means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

**Protective laboratory practices and equipment** means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

Test for Flash Point by Setafash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

**Hazardous chemical** means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term **health hazard** includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

**Laboratory** means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

**Laboratory scale** means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

**Laboratory-type hood** means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided

*Reproductive toxins* means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

*Select carcinogen* means any substance which meets one of the following criteria:

- (i) It is regulated by OSHA as a carcinogen; or
- (ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
- (iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
- (iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to doses of less than 10 mg/m<sup>3</sup>;

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

*Unstable (reactive)* means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

*Water-reactive* means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

(c) *Permissible exposure limits.* For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d) *Employee exposure determination—(1) Initial monitoring.* The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure lev-

els for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(2) *Periodic monitoring.* If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(3) *Termination of monitoring.* Monitoring may be terminated in accordance with the relevant standard.

(4) *Employee notification of monitoring results.* The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e) *Chemical hygiene plan—General.* Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan.)

(1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(2) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(i) Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hy-

giene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(iii) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(iv) Provisions for employee information and training as prescribed in paragraph (f) of this section;

(v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(vii) Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and

(viii) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(A) Establishment of a designated area;

(B) Use of containment devices such as fume hoods or glove boxes;

(C) Procedures for safe removal of contaminated waste; and

(D) Decontamination procedures.

(4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

(f) *Employee information and training.*

(i) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(2) Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and

prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

(3) *Information.* Employees shall be informed of:

(i) The contents of this standard and its appendices which shall be made available to employees;

(ii) The location and availability of the employer's Chemical Hygiene Plan;

(iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(iv) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

(4) *Training.* (i) Employee training shall include:

(A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(B) The physical and health hazards of chemicals in the work area; and

(C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) *Medical consultation and medical examinations.* (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(1) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(ii) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(3) Information provided to the physician. The employer shall provide the following information to the physician:

(i) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(iii) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(4) Physician's written opinion. (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

(C) Any medical condition which may be revealed in the course of the examination which may place the employee

at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(D) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(ii) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h) Hazard identification. (1) With respect to labels and material safety data sheets:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(2) The following provisions shall apply to chemical substances developed in the laboratory:

(i) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(ii) If the chemical produced is a by-product whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(iii) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

(i) Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accord-

ance with the requirements of 29 CFR 1910.134.

(i) Recordkeeping. (1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) Dates—(1) Effective date. This section shall become effective May 1, 1990. (2) Start-up dates. (i) Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(ii) Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(i) Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[55 FR 3327, Jan. 31, 1990, 55 FR 7067, Mar. 6, 1990, 55 FR 12111, Mar. 30, 1990]

APPENDIX A TO § 1910.1450—NATIONAL RESEARCH COUNCIL RECOMMENDATIONS CONCERNING CHEMICAL HYGIENE IN LABORATORIES (NON-MANDATORY)

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#### Foreword

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for Handling Hazardous Chemicals in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., NW., Washington DC 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemi-

cal hazards. Moreover, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

#### Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard	Relevant appendix section
(e)(3)(i) Standard operating procedures for handling toxic chemicals.	C, D, E
(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposures.	D
(e)(3)(iii) Fume hood performance.	C4b
(e)(3)(iv) Employee information and training (including emergency procedures).	D10, D9
(e)(3)(v) Requirements for prior approval of laboratory activities.	E2b, E4b
(e)(3)(vi) Medical consultation and medical examinations.	D8, E4
(e)(3)(vii) Chemical hygiene responsibilities.	B
(e)(3)(viii) Special precautions for work with particularly hazardous substances.	E2, E3, E4

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

#### A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact

with chemicals should be avoided as a cardinal rule (189).

2. Avoid underestimation of risk. Even for substances of no known significant hazard, exposures should be minimized; for work with substances which present special hazards, special precautions should be taken (10, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30, 103) and that all substances of unknown toxicity are toxic (3, 34).

3. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 188).

4. Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

5. Observe the PELs, TLVs, The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

#### B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all levels (6, 11, 21) including the:

1. Chief executive officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene (7, 11).
2. Supervisor of the department or other administrative unit, who is responsible for chemical hygiene in that unit (7).
3. Chemical hygiene officer(s), whose appointment is essential (7) and who must:
  - (a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);
  - (b) Monitor procurement, use, and disposal of chemicals used in the lab (8);
  - (c) See that appropriate audits are maintained (8);
  - (d) Help project directors develop precautions and adequate facilities (10);
  - (e) Know the current legal requirements concerning regulated substances (50); and
  - (f) Seek ways to improve the chemical hygiene program (8, 11).
4. Laboratory supervisor, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:
  - (a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);
  - (b) Provide regular, formal chemical hygiene and housekeeping inspections includ-

ing routine inspections of emergency equipment (21, 171);

- (c) Know the current legal requirements concerning regulated substances (50, 231);
- (d) Determine the required levels of protective apparel and equipment (156, 160, 162); and
- (e) Ensure that facilities and training for use of any material being ordered are adequate (215).

5. Project director or director of other specific operation, who has primary responsibility for chemical hygiene procedures for that operation (7).

- (a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and
- (b) Developing good personal chemical hygiene habits (22).

#### C. The Laboratory Facility

1. Design. The laboratory facility should have:
  - (a) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);
  - (b) Adequate, well-ventilated stockrooms/storerooms (218, 219);
  - (c) Laboratory hoods and sinks (12, 162);
  - (d) Other safety equipment including eyewash fountains and drench showers (162, 169); and
  - (e) Arrangements for waste disposal (12, 240).

2. Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11, 12).

3. Usage. The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

4. Ventilation—(a) General laboratory ventilation. This system should: Provide a source of air for breathing and for input to local ventilation devices (189); it should not be relied on for protection from toxic substances released into the laboratory (189); ensure that laboratory air is continually replaced, preventing increases of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building (194).

- (b) Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (189); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (189). See pp.

201-206 for a discussion of design, construction, and evaluation.

- (c) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (189). Each canopy hood and snorkel should have a separate exhaust duct (207).
- (d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure (209).

- (e) Modifications. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 183, 204).
- (f) Performance. Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

- (g) Quality. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194, 195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 fpm) (200, 204).

- (h) Evaluation. Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 185, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

#### D. Components of the Chemical Hygiene Plan

1. Basic Rules and Procedures (Recommendations for these are given in section E, below)

2. Chemical Procurement, Distribution, and Storage

- (a) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (215, 216). No container should be accepted without an adequate identifying label (216). Preferably, all substances should be received in a central location (216).
- (b) Stockrooms/storerooms. Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for

replacement, ventilation, and container integrity (218-1450).  
Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) *Distribution*. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).  
(d) *Laboratory storage*. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unused items being discarded or returned to the storeroom/stockroom (225-6, 229).

### 3. Environmental Monitoring

Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

### 4. Housekeeping, Maintenance, and Inspections

(a) *Cleaning*. Floors should be cleaned regularly (24).  
(b) *Inspections*. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for others; informal inspections should be continual (21).

(c) *Maintenance*. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should be inspected regularly (e.g., every 3-6 months) (6, 24, 171). Procedures to prevent restarting of out-of-service equipment should be established (25).  
(d) *Passageways*. Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

### 5. Medical Program

(a) *Compliance with regulations*. Regular medical surveillance should be established to the extent required by regulations (12).  
(b) *Routine surveillance*. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 60).  
(c) *First aid*. Personnel trained in first aid should be available during working hours

and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

### 6. Protective Apparel and Equipment

These should include for each laboratory:  
(a) Protective apparel compatible with the required degree of protection for substances being handled (158-161);  
(b) An easily accessible drench-type safety shower (162, 169);  
(c) An eyewash fountain (162);  
(d) A fire extinguisher (162-164);  
(e) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and  
(f) Other items designated by the laboratory supervisor (166, 168).

### 7. Records

(a) Accident records should be written and retained (174).  
(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).  
(c) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.  
(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

### 8. Signs and Labels

Prominent signs and labels of the following types should be posted:  
(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);  
(b) Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);  
(c) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and  
(d) Warnings at areas or equipment where special or unusual hazards exist (27).

### 9. Spills and Accidents

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).  
(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).  
(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

### 10. Information and Training Program

(a) *Aim*: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(b) *Emergency and Personal Protection Training*: Every laboratory worker should know the location and proper use of available protective apparel and equipment (164, 168).

Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (8). Such training as well as first aid instruction should be available to (164) and encouraged for (176) everyone who might need it.

(c) *Receiving and stockroom/storeroom personnel* should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) *Frequency of training*: The training and education program should be a regular, continuing activity—not simply an annual presentation (15).

(e) *Literature/consultation*: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

### 11. Waste Disposal Program

(a) *Aim*: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) *Content* (14, 232, 233, 240): The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) *Discarding Chemical Stocks*: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 27).

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (228).

(d) *Frequency of Disposal*: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(e) *Method of Disposal*: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241). Indiscriminate disposal by pouring waste chemicals down the drain (14, 231, 242) or add-

ing them to mixed refuse for landfill burial is unacceptable (14).  
Hoods should not be used as a means of disposal for volatile chemicals (40, 200).

Disposal by recycling (233, 243) or chemical decontamination (40, 230) should be used when possible.

### E. Basic Rules and Procedures for Working with Chemicals

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

#### 1. General Rules

The following should be used for essentially all laboratory work with chemicals:

(a) *Accidents and spills—Eye Contact*: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

*Ingestion*: Encourage the victim to drink large amounts of water (178).

*Skin Contact*: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 179). If symptoms persist after washing, seek medical attention (33).

*Clean-up*: Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(b) *Avoidance of "routine" exposure*: Develop and encourage safe habits (23); avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (169).

Inspect gloves (167) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres (209).

(c) *Choice of chemicals*: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) *Eating, smoking, etc.*: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities (23, 24).

Avoid storage, handling or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e) *Equipment and glassware*: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (25). Use extra care with Dewar flasks and

other evacuation apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 28).

(f) *Exiting*: Wash areas of exposed skin well before leaving the laboratory (23).

(g) *Houseplay*: Avoid practical jokes or other behavior which might confuse, startle or distract another worker (23).

(h) *Mouth suction*: Do not use mouth suction for pipetting or starting a siphon (23, 32).

(i) *Personal apparel*: Confine long hair and loose clothing (23, 158). Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(j) *Personal housekeeping*: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24); (k) *Personal protection*: Assume that appropriate eye protection (154-166) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 164). Wear appropriate gloves when the potential for contact with toxic materials exists (167); inspect the gloves before each use, wash them before removal, and replace them periodically (167). (A table of resistance to chemicals of common glove materials is given p. 169).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (164-6), inspecting the respirator before use (168). Use any other protective and emergency apparel and equipment as appropriate (22, 167-162). Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (165). Remove laboratory coats immediately on significant contamination (161).

(l) *Planning*: Seek information and advice about hazards (?), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23). (m) *Unattended operations*: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(n) *Use of hood*: Use the hood for operations which might result in release of toxic chemical vapors or dust (198-9). As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13). Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being

made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200). Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) *Vigilance*: Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) *Waste disposal*: Assume that the plan for each laboratory operation includes plans and training for waste disposal (230). Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22, 24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) *Working alone*: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (26). 2. Working with Allergens and Embryotoxins (a) *Allergens* (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(b) *Embryotoxins* (34-5) (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact. Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made. Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container. Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity **EXAMPLES:** diisopropylfluorophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45). Supplemental rules to be followed in addition to those mentioned above (Procedure B of "Prudent Practices", pp. 39-41): (a) *Aim*: To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) *Applicability*: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) *Location*: Use and store these substances only in areas of restricted access with special warning signs (40, 229).

Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 80 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(d) *Personal protection*: Always avoid skin contact by use of gloves and long sleeves and other protective apparel as appropriate (38). Always wash hands and arms immediately after working with these materials (40).

(e) *Records*: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) *Prevention of spills and accidents*: Be prepared for accidents and spills (41). Assume that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) *Waste*: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

#### 4. Work with Chemicals of High Chronic Toxicity

(Examples: dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), Nitrosodimethylamine (54), other human carcinogens or substances with high carcinogenic potency in animals (38).)

Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(a) *Access*: Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly

toxic substances, for which all people with access are aware of the substances being used and necessary precautions (48).

(b) *Approvals*: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(c) *Non-contamination/Decontamination*: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50). Decontaminate the controlled area before normal work is resumed there (50).

(d) *Exiting*: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) *Housekeeping*: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) *Medical surveillance*: If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) *Records*: Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) *Signs and labels*: Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) *Spills*: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(j) *Storage*: Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) *Glove boxes*: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood (49).

(l) *Waste*: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 223).

5. Animal Welfare and Chemical Toxicity

(a) Access: For large scale studies, special facilities with restricted access are preferable (56).

(b) Administration of the toxic substance: When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

(c) Aerosol suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (56, 59).

(d) Personal protection: When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(e) Waste disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise, package the waste appropriately for burial in an EPA-approved site (239).

F. Safety Recommendations

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6)
2. Electrically powered laboratory apparatus: (179-82)
3. Fires, explosions: (26, 57-74, 102-4, 174-5, 219-20, 228-7)
4. Low temperature procedures: (28, 83)
5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. Material Safety Data Sheets

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided.)

- \*Acetyl peroxide (105)
- \*Acrolein (109)
- \*Acrylonitrile (107)

- Ammonia (anhydrous) (91)
- \*Aniline (109)
- \*Benzene (110)
- \*Benzofluorene (112)
- \*Bis(chloromethyl) ether (113)
- Boron trichloride (91)
- Boron trifluoride (92)
- Bromine (114)
- \*tert-Butyl hydroperoxide (148)
- \*Carbon disulfide (116)
- \*Carbon monoxide (92)
- \*Carbon tetrachloride (118)
- \*Chlorine (119)
- Chlorine trifluoride (94)
- \*Chloroform (121)
- Chloromethane (93)
- \*Diethyl ether (122)
- Diisopropyl fluorophosphate (41)
- \*Dimethylformamide (123)
- \*Dimethyl sulfate (125)
- \*Dioxane (126)
- \*Ethylene dibromide (128)
- \*Fluorine (95)
- \*Formaldehyde (130)
- \*Hydrazine and salts (132)
- Hydrofluoric acid (43)
- Hydrogen bromide (98)
- Hydrogen chloride (98)
- \*Hydrogen cyanide (133)
- \*Hydrogen sulfide (135)
- Mercury and compounds (92)
- \*Methanol (137)
- \*Morpholine (138)
- \*Nickel carbonyl (99)
- \*Nitrobenzene (139)
- Nitrogen dioxide (100)
- N-nitrosodimethylamine (54)
- \*Peracetic acid (141)
- \*Phenol (142)
- \*Phosgene (143)
- \*Pyridine (144)
- \*Sodium azide (145)
- \*Sodium cyanide (147)
- Sulfur dioxide (101)
- \*Trichloroethylene (149)
- \*Vinyl chloride (150)

APPENDIX B TO § 1910.1450—REFERENCES (NON-MANDATORY)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory. (a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, *Safety in Academic Chemistry Laboratories*, 4th edition, 1983.
2. Fawcett, H.H. and W. S. Wood, *Safety and Accident Prevention in Chemical Operations*, 2nd edition, Wiley-Interscience, New York, 1982.

Flury, Patricia A., *Environmental Health and Safety in the Hospital Laboratory*, Charles C. Thomas Publisher, Springfield IL, 1978.

4. Green, Michael E. and Turk, Amos, *Safety in Working with Chemicals*, Macmillan Publishing Co., NY, 1978.

5. Kaufman, James A., *Laboratory Safety Guidelines*, Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.

6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO, Washington, DC 20402, 1981.

7. National Research Council, *Prudent Practices for Disposal of Chemicals from Laboratories*, National Academy Press, Washington, DC, 1983.

8. National Research Council, *Prudent Practices for Handling Hazardous Chemicals in Laboratories*, National Academy Press, Washington, DC, 1981.

9. Reinrow, Malcolm, Ed., *Safety in the Chemical Laboratory*, Vol. IV, J. Chem. Ed., American Chemical Society, Eason, PA, 1981.

10. Steere, Norman V., Ed., *Safety in the Chemical Laboratory*, J. Chem. Ed., American Chemical Society, Eason, PA, 1984, Vol. I, 1987, Vol. II, 1971, Vol. III 1974.

11. Steere, Norman V., *Handbook of Laboratory Safety*, the Chemical Rubber Company, Cleveland, OH, 1971.

12. Young, Jay A., Ed., *Improving Safety in the Chemical Laboratory*, John Wiley & Sons, Inc. New York, 1987.

(b) Hazardous Substances Information:

1. American Conference of Governmental Industrial Hygienists, *Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes*, 6500 Glenway Avenue, Bldg. D-7 Cincinnati, OH 45211-4438 (latest edition).

2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC, (latest edition).

3. Best Company, *Best Safety Directory*, Vols. I and II, Oldwick, N.J., 1981.

4. Bretherick, L., *Handbook of Reactive Chemical Hazards*, 2nd edition, Butterworths, London, 1979.

5. Bretherick, L., *Hazards in the Chemical Laboratory*, 3rd edition, Royal Society of Chemistry, London, 1986.

6. Code of Federal Regulations, 29 CFR part 1910 subpart Z, U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

7. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).

8. NIOSH/OSHA Pocket Guide to Chemical Hazards, NIOSH Pub. No. 85-114, U.S. Gov-

ernment Printing Office, Washington, DC, 1985 (or latest edition).

9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Printing Office, Washington, DC, 1981.

10. Patty, F.A., *Industrial Hygiene and Toxicology*, John Wiley & Sons, Inc., New York, NY (Five Volumes).

11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.

12. The Merck Index: An Encyclopedia of Chemicals and Drugs, Merck and Company Inc. Rahway, N.J., 1976 (or latest edition).

13. Sax, N.I. *Dangerous Properties of Industrial Materials*, 5th edition, Van Nostrand Reinhold, NY., 1979.

14. Stittig, Marshall, *Handbook of Toxic and Hazardous Chemicals*, Noyes Publications, Park Ridge, NJ, 1981.

(c) Information on Ventilation:

1. American Conference of Governmental Industrial Hygienists *Industrial Ventilation* (latest edition), 6500 Glenway Avenue, Bldg. D-7, Cincinnati, Ohio 45211-4438.

2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y. 1979.

3. Imad, A.P. and Watson, C.L. *Ventilation Index: An Easy Way to Decide about Hazardous Liquids*, Professional Safety pp 15-18, April 1980.

4. National Fire Protection Association, *Fire Protection for Laboratories Using Chemicals NFPA-46*, 1982.

5. Safety Standard for Laboratories in Health Related Institutions, NFPA, 59c, 1980.

6. Fire Protection Guide on Hazardous Materials, 7th edition, 1978.

7. National Fire Protection Association, *Batterymarch Park, Quincy, MA 02289*.

8. Scientific Apparatus Makers Association (SAMA), *Standard for Laboratory Fume Hoods*, SAMA LF7-1980, 1101 16th Street, NW., Washington, DC 20036.

(d) Information on Availability of Referenced Material:

1. American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.
2. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

(Approved by the Office of Management and Budget under control number 1216-0131)

[55 FR 3327, Jan. 31, 1990; 55 FR 7987, Mar. 6, 1990; 57 FR 29204, July 1, 1992]

**14.2     ATTACHMENT: Sunflower AAP : General Safety Guide for Subcontractors Lower-Tier**  
**Subcontractors and Their Employees**

**Sunflower AAP**

**Sunflower AAP**

**Sunflower AAP**

**GENERAL SAFETY GUIDE**

**FOR**

**SUBCONTRACTORS**

**LOWER-TIER**

**SUBCONTRACTORS**

**AND**

**THEIR EMPLOYEES**

**HERCULES**

**REVISED SEPT. 1992**

## Subcontractor Safety Meeting Checklist

Subcontract Number \_\_\_\_\_

Date \_\_\_\_\_

Name of Subcontractor \_\_\_\_\_

**Superintendent** \_\_\_\_\_

**Hercules Engineer in Charge** \_\_\_\_\_

**Safety Engr.**

Reviewed

N/A

## 1. Route to Worksite

- a. Speed limit, seat belts, backing guide
- b. Emergency vehicles, Powder vehicles
- c. Parking

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## 2. Work Site Limitations

- a. Building Limits
- b. Assembly areas/storm shelters - test plant warning system (normally Wed. at 10:00 a.m.)
- c. PPE, hard hats, safety shoes, safety glasses w/side shields
- d. Hazard Communication Law - MSDS
- e. Housekeeping
- f. Hot Work Permits, Confined Space Entry, Smoking Stations
- g. Electrical Lockout/Tagout
- h. Excavating and Trenching
- i. Lifting and Material Handling Equipment
- j. Ladders and Scaffolds
- k. Floors, wall openings and stairways
- l. Hand and Power Tools
- m. Asbestos (removal, renovation, repair)  
Notify Industrial Hygiene for PPE and special work practice requirements.
- n. Radiation Producing Devices (contact DOA Environmental Office for permit)

[illegible]

### 3. Emergency Notifications

- a. EMT's, hospital Ph 3333 24 hours
- b. Fires, spills Ph 3333 24 hours
- c. Area fire phones, located in gray box on utility poles marked with red bands
- d. Safety meetings

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Comments: 1FR 29-1910.181 (d) INSPECTION

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Badge No.

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## Foreword

It is the intent of Hercules Incorporated, Sunflower Army Ammunition Plant, to comply with all Federal, State, and local regulations concerning Occupational Safety and Health, Solid and Hazardous Waste Management, and Environmental Controls. Hercules Incorporated is using every known means to make SFAAP a safe place to work for both Hercules employees and the employees of our subcontractors. Responsibility for safety of the subcontractor and his employees rests upon the subcontractor who is expected to take all the steps necessary to establish, administer, and enforce safety rules.

## Safety Rules

Safety is the number one priority at Sunflower Army Ammunition Plant. Therefore, all persons on the plant, including subcontract personnel, shall comply with the plant safety rules at all times.

This booklet explains many of the safety rules in effect at SFAAP. Subcontractors are expected to perform their work in a safe manner so as to not endanger themselves, SFAAP employees, or government property.

## Introduction

Sunflower Army Ammunition Plant (SFAAP) is presently engaged in the manufacture of propellants for the United States Army. Some of the ingredients used in making the propellants are nitric acid, oleum, and sulfuric acid, calcium carbide, ammonium nitrate, nitrocellulose, nitroglycerin, and ammonia. These products are extremely hazardous while being used in the plant operation.

Curiosity can cause accidents and fatalities. Your safety, as well as that of Hercules employees, requires strict observance of all safety rules. This booklet is furnished to help you better acquaint yourself with the common safety procedures and other standard practices at Sunflower Army Ammunition Plant.

We appreciate and expect your cooperation in helping us to maintain safe and efficient plant operations.

## References

- ANSI: American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018
- OSHA: Occupational Safety and Health Administration, U. S. Department of Labor, Washington, D.C. Kansas City Regional Office - Region VII: Regional Administrator, U. S. Department of Labor - OSHA, 911 Walnut Street, Room 3000, Kansas City, MO 64106
- NFPA: National Fire Protection Association, Batterymarch Park, Quincy, MA 02269

## Definitions

**Hercules:** Any reference to "Hercules" shall mean Hercules Incorporated (Hercules is the contractor, i.e., the Operating Contractor).

**Subcontractor:** The word "Subcontractor" shall mean the company, corporation, firm and all lower tier subcontractors to which Hercules has subcontracted the work by means of the prime subcontract.

**Shall:** As used in this document means mandatory; for example: items that must be complied with.

**Will:** As used in this document means desirable (not mandatory); for example: items that may be accomplished.

## Right to Know

The Hazard Communication Standard requires employers to provide information on all hazardous substances that may be present in the work place. Subcontractors bringing hazardous materials on to Sunflower Army Ammunition Plant are required to provide Hercules with Material Safety Data Sheets (MSDS) for each material. (The manufacturer of the material is required to provide MSDS's with the hazardous substance.) Hercules will provide subcontractors with MSDS on Hercules process substances and materials that subcontractors may be exposed to at their work site.

The subcontractor is required by CFR 1910.1200 to inform and train their employees on all hazardous substances in the work place. All containers shall be appropriately labeled and vehicles placarded. These requirements will be monitored by the Hercules Safety/Fire Department. If deficiencies are found, they shall be corrected immediately.

## Emergency Calls

**Plant Telephones:** Numbers to be called for emergency and routine business information:

	<u>Emergency</u>	<u>Extension #</u>
Fire Department (Fire Only)	3333	6755
Ambulance - Fire Department	3333	6755
Spills - Fire Department	3333	6870
Security Department	3300	6767
Desk Sergeant - Security Department	3300	6767
Disaster - Security Department	3300	6767
Safety Department	6824	6871
Work Permits - Fire Department	3333	6755

### Fires

All fires, regardless of size or content, must be reported immediately to the Fire Department, extension 3333. Be familiar with the method to be used in giving the alarm in case of fire, dial extension 3333 to report a fire. State what is burning, location of fire, your name, where responding unit will meet you, and do not hang up before the Fire Department operator acknowledges or hangs up.

### Emergency Phones

Throughout the plant we have strategically placed direct call Emergency Phones. These phones are a direct line to the SFAAP Fire Department; no dialing is necessary. They are recognizable by being mounted on poles with two red stripes and a white band between them.

If a fire phone is available, pick up transmitter, wait for department answer, relay same information. Fire phones may be used for all emergencies. Fire phones are located in a gray box on utility poles marked with red bands. The project engineer will locate emergency phones for the subcontractor.

## Emergency Calls cont'd

### In Case of Accident - Injuries

For ambulance, dial Fire Department extension 3333 from the nearest plant telephone and state the following: location of accident, your name, and any information known regarding the accident. Do not hang up until the Fire Department operator does. All injuries will be treated at the plant hospital as set forth in the subcontract documents.

### Incoming Calls

The Sunflower Army Ammunition Plant switchboard numbers are (913) 791-6700 (Kansas City Area) and (913) 585-3000 (DeSoto Area).

## Severe Weather and Emergency Disaster Warnings

Severe storm warning and emergency disaster situations are transmitted plant wide by sounding of the plant sirens. If plant sirens malfunction, the severe weather emergency disaster warning is transmitted by conventional phones, red telephones, and loud speaker equipped mobile units. Warnings are as follows:

### **"Take Cover"**

Severe weather, continual alarm/siren for a period of three (3) minutes.

### **"Civil Defense/Nuclear Attack Warning"**

Three (3) to five (5) minute wavering sound of plant sirens.

### **"All Clear"**

Signal consisting of two (2) 15 second blasts of the plant siren will be sounded, also transmission verbally using mobile loud speakers.

The plant sirens are tested every Wednesday at 10:00 a.m.

Personnel shall know the location of emergency shelters in their work area. The project engineer will determine location and inform the subcontractor of the nearest shelter.

Job superintendents will be responsible for accounting for their personnel, and informing the SFAAP Fire Department of any missing personnel.

## General Rules and Regulations

### A. ENTRY INTO PLANT:

1. Subcontractor personnel shall be permitted entry to this installation from 103<sup>rd</sup> Street (Old K-10) through plant Gate 1, (Main Gate). Entry through any gate other than Gate 1, shall be arranged through the plant Security Department.
2. All plant roadways, over which subcontractor travel is permitted, will be shown on a plant map provided by the Hercules Engineer in charge.
3. The Hercules Engineer in charge will arrange, with the plant Security Department, identification badges for all subcontractor personnel prior to entry into the vital area of the plant. Each subcontractor employee must wear his/her badge at all times in a conspicuous place on his/her person, preferably on the upper left hand side of the chest on his/her outer garment when on plant site. Passes for special visitors must be handled through the Hercules Engineer in charge. All subcontractor personnel will be required to attend a Safety meeting prior to being badged for entry to the plant.

### B. Violators of the Following Regulations Are Subject to Disciplinary Action, Immediate Expulsion, and/or Criminal Prosecution

1. Matches, pocket cigarette lighters, cigarette lighter fluid, vehicle cigarette lighters, road flares, and all other flame producing devices are prohibited within the vital area.
2. The following items are CONTRABAND and may be confiscated: cameras, binoculars, telescopes, firearms, and any other weapon, ammunition, illicit drugs, narcotics, alcoholic beverages, spring blade knives, razors, hunting or butcher knives, pocket knives with a blade of three (3) inches or more, dice, playing cards, and gambling devices of any kind.
3. Subcontractor vehicles and employers are subject to search for CONTRABAND at any time while on plant property.

## General Rules and Regulations cont'd

4. Smoking is prohibited inside the vital area except during the periods established by the subcontractor superintendent. Smoking stations shall be permitted in areas designated by the Hercules Safety/Fire Department.
5. Speeding and careless driving will not be tolerated. The maximum speed limit is 25 mph unless otherwise posted. Posted speed limits and all other traffic signs must be observed. Vehicles shall be parked 50 feet or more from buildings, tanks, and structures in such a manner as to not create a traffic hazard.
6. Driving under the influence of intoxicating liquor and drugs, fighting, and disorderly conduct are prohibited.
7. Damaging, misusing government property, pilfering, and attempting to steal government property are prohibited. Violators are subject to fine, or imprisonment, or both under Title 17, United States Code, Crimes, and Criminal Procedure, Chapter 67, Section 1383.
8. Seat belts must be worn at all times.
9. Passing of busses loading or unloading is strictly prohibited.
10. Backing guide policy - A vehicle will not be backed up unless the movement can be made safely. When backing a vehicle, the driver will use a guide (if available) to assist with backing maneuver. If no one is present to assist, the driver will walk around the vehicle to assure that the maneuver can be conducted safely.

## Safety Meetings

The job supervisor shall hold a safety meeting with employees before starting every job. All employees shall be required to attend these meetings. After the original meeting, the subcontractor shall have a minimum of one safety meeting per month. These meetings shall be documented on a form provided by Hercules and forwarded to the Hercules Safety Department by the 5th of each month.

Unsafe conditions and unsafe work practices noted on the project shall be brought to the attention of the workers as well as the proposed method for eliminating any further occurrences. The person holding the meeting shall also discuss the work that will take place and bring to the workers' attention any possible hazards pertaining to the type of work to be performed.

Workers should be encouraged to ask questions and make safety suggestions at these meetings. When new employees come on the job, they shall receive the same information.

## Safety Injury Reporting

In the event an injury should occur the Hercules Emergency Medical Team should be notified at extension 3333. Each subcontractor is responsible for keeping an injury log. The log must identify as a minimum, name of employee, date and time of injury, brief description of how injury occurred, and supervisor's name. The log must be made available to the Hercules Safety Office.

## Fire Prevention and Protection for Subcontractors and Lower Tier Subcontractors

A fire prevention program is a pre-planned approach aimed at protecting life and property by preventing fires. By pre-planning, the loss can be greatly reduced or eliminated.

Too often, fire protection is given only minor consideration or ignored completely. Yet, the lack of adequate planning has often been a major cause or contributed to serious fires. At Sunflower Army Ammunition Plant, the main objective is to eliminate the causes of fire and prevent loss of life, injuries, and property damage. Thus, fire prevention is stressed.

- A. In case of fire dial extension 3333 (fire phone requires no dialing) and report location. Plant Fire Department personnel will respond with necessary fire control or prevention measures.
- B. Fire hoses, hydrants, monitor nozzles, sprinkler systems, fire extinguishers, the fire trucks, and other fire protection devices are for use only in case of fire. They must not be used for any other purpose except by permission from the Safety and/or Fire Department.
- C. Subcontractor shall furnish and maintain his own fire extinguishers on the job site. Fire extinguishers shall be the correct classification and rating.
- D. A fire extinguisher with A, B, C or at a minimum BC rating is needed at all work sites where hot work is performed. Fire extinguishers are required. The minimum size and class of fire extinguishers shall be in compliance with one of the listed extinguishers for each category:

<u>Size</u>
5# ABC, or 10# BC
10# ABC, or 60# BC

10# ABC, 60# BC

<u>Category</u>
In all vehicles.
Protection should be with all gasoline or diesel-powered equipment, welding machines, compressors, etc.
Where transporting or temporarily storing large quantities of flammable or combustible liquids.

**Fire Prevention and Protection for**  
**Subcontractors and Lower Tier Subcontractors cont'd**

<u>Size</u>	<u>Category</u>
20# ABC, or 120# BC	Where transporting or temporarily storing large quantities of flammable or combustible liquids.

Use hand extinguishers and hose streams as follows:

1. For fires in materials, such as wood and rags (Class A) use a water type fire extinguisher or hose streams.
  2. For fires of flammable liquids (Class B) such as ether, alcohol, and oil use carbon dioxide, dry-chemical or foam-type extinguishers.
  3. For all electrical fires (Class C), use carbon dioxide, Halon, or dry chemical extinguishers. Never use anything else. You could be electrocuted if water is used.
  4. For clothing fires, one should get under a sprinkler system, safety shower, or roll on the ground. Never run.
  5. In areas protected by fixed Halon extinguishing systems, leave the area immediately when the system activates. Close doors behind you, if possible, as you leave.
- E. Clothing must not be hung on fire extinguishers and sprinkler heads. Access to fire extinguishers must not be blocked by stored equipment and materials. Do not stack material closer than three (3) feet below sprinkler heads. If you find a condition that may cause or contribute to a fire, report the condition to your foreman or supervisor immediately.
- F. When it is necessary to have heat-producing equipment, power tools, or use a flame/spark producing device on the plant for any purpose, obtain a hot work permit and follow the instructions.
- G. Subject to approval by the Safety/Fire Department, no fire may be lighted unless a fire extinguisher is available, or a connected hose to a water supply is rolled out, pressurized, and ready for use. A fire watch must be standing by.

**Fire Prevention and Protection for**  
**Subcontractors and Lower Tier Subcontractors cont'd**

- H. Whenever firefighting equipment is used, report the use to the Fire Department for replacement or recharging. The equipment must not be returned to storage as if in a ready condition after using, without first being checked by qualified Fire Department personnel.
- I. Baled materials, skids, racks, boxes, crates, bags, packages, other materials and equipment, shall be stacked/piled so as not to block aisles, exits, hose boxes, fire extinguishers, alarm boxes, electrical lighting and power panels, valves, etc. Fire doors must be kept clear and maintained in good operating condition so that they will close readily. Never block a fire door or prevent it from closing.
- J. **Handling Flammable Liquids:**
  - 1. Only NFPA approved safety cans shall be used for dispensing flammable liquids.
  - 2. Safety cans shall be painted red and contents identified with yellow letters as to contents.
- K. Only small amounts of solvents shall be kept in a ventilated room or building and then only with permission of the Safety/Fire Department and area manager or supervisor. Approved designated storage cabinets shall be used for all material not needed for immediate use.
- L. Spills of flammable liquids must be reported and cleaned up at once. Until the spill is cleaned up, every precaution must be taken to avoid striking a spark and igniting the liquid. Should a leak or spill occur, immediately report the condition to the supervisor in charge. SFAAP Fire Department must be notified immediately at extension 3333. Every effort must be taken to prevent an accumulation of flammable liquids and materials in any building.
- M. Learn the location of all fire exits in your building. All exits must be unlocked. These exits are posted with a readily visible sign.
- N. Maintain good housekeeping. Always remember, "the time to fight a fire is before it occurs." That is, do not create a potential fire hazard.
- O. Smoking is prohibited within the plant security fences unless authorized by the Hercules Safety/Fire Department.

## Smoking and Heat/Flame Producing Devices

Smoking is prohibited except in designated smoking areas for obvious reasons. No one is permitted to carry flame, heat, and spark producing devices without a written permit issued and signed by a member of the Safety/Fire Department. A permit to carry a flame or spark producing device is not a permit to use the device. A hot work permit must be authorized for each use of such devices.

The following is the minimum requirement that must be met to obtain a hot work permit for smoking:

1. Lighters for smoking shall be fixed electric type attached to stationary structures.
2. Smoking is not permitted anywhere inside the vital area of SFAAP except in Hercules approved smoking stations.
3. Pocket lighters, matches, and vehicle cigarette lighters shall be turned in at guard gates. If a person finds matches or other flame producing devices on the plant or on his person, (except during a search), he shall immediately and openly bring them to a security police officer or his supervisor without any penalty.
4. A validated Hot Work Permit will be displayed within each smoking station.
5. The subcontractor will equip each of his smoking stations with a sand filled butt can, a covered trash can, and a freeze-proof water type fire extinguisher.
6. The subcontractor is responsible for housekeeping within, and adjacent to, all smoking stations used exclusively by his personnel. Combustible materials are not allowed in, or adjacent to, smoking stations.
7. If a Hercules smoking station is designated for subcontractor use, the posted times shall be observed.

## Hot Work Permits

The purpose of Hot Work Permits is to prevent fires and incidents by controlling the use of power driven tools and equipment which produce heat, spark, and open flame.

A Hot Work Permit is required for the possession, transportation, and use of heat, spark, and flame producing tool and equipment here at Sunflower Army Ammunition Plant.

Hot Work Permits are issued by the Hercules representative and validated by a Hercules building supervisor, Fire/Safety Department and the subcontractor superintendent. The tools, equipment, and job sites will be inspected before the Hot Work Permit is validated. All personnel involved in the execution of the hot work shall familiarize themselves with the requirements established on the Hot Work Permit.

Validated Hot Work Permits shall be displayed adjacent to the work location. In some cases, the person responsible for the hot work will be allowed to carry the permit on his person.

The following examples require a Hot Work Permit:

- a. Use of smoking station
- b. Possession of approved safety matches in a standard metal match container and/or a sparking device at any location within the vital area
- c. Welding and cutting
- d. Burning
- e. Soldering
- f. Leading
- g. Babbitting
- h. Chipping
- i. Grinding/polishing
- j. Sandblasting
- k. Jackhammering
- l. Drilling
- m. Space heating equipment
- n. Internal combustion engines, i.e., chain saws, air compressors

Fire pots (hot asphalt kettle) must be located at least fifty (50) feet from any structure (including tanks). Igniting a flame shall not take place unless a charged water hose or approved fire extinguisher is close at hand.

## Hot Work Permits cont'd

Recognized fire prevention practices shall be observed and standard fire extinguishing equipment shall be maintained at or adjacent to work locations covered by the Hot Work Permit(s). Fire extinguishers must be in good operating condition and must be recharged or replaced immediately after the extinguisher has been used. Fire hose and other fire protection devices shall be used only in case of fire. Exits to fire doors must be kept clear of obstructions.

Extreme caution shall be exercised in welding operations. Water or a suitable fire extinguisher must be on hand. The area shall be free of rubbish and flammables. When burning or welding overhead, a person must be assigned to the lower level to guard against fire and warn pedestrians. Electric arc welders must, wherever possible, use suitable screens to prevent exposure of other personnel to the rays from the arc.

Before leaving a site of welding or burning, the area must be surveyed carefully by subcontractor personnel to assure no smoldering traces of fire exist. This check must be done no earlier than thirty (30) minutes after stopping hot work.

Unattended fires are not permitted. Tar pots and melting pots must be attended at all times while in use. Oil stoves, propane gas heaters and other open flame heating devices shall not be used unless approved by Hercules Fire/Safety Department.

Instructions written on Hot work Permits pertaining to life, safety, and fire prevention, shall be adhered to. Violation shall result in the Hot Work Permit being revoked and work stopped until the violation is corrected. Tarpaulins which are used must be flame-proofed or fire retardant.

Should an unusual cloud/vapor/fumes/smoke be observed or a strange odor become evident during hot work, all hot work shall stop. Personnel shall be evacuated and a Hercules representative shall be notified immediately. If any propellant or unfamiliar material is discovered during the work effort, stop work immediately and notify the Hercules Safety/Fire Department for additional cleaning and instructions.

### Working Late

Any subcontractor that is working outside of the normal 7-4 working hours or on weekends must notify the Security and Fire Departments in advance. This is so the area may be checked after work completion for the day.

## Control of Confined Space Entry

A confined space is defined as: (1) A space which has limited openings for entry and exit. (2) A space which has unfavorable natural ventilation which could contain or produce dangerous air contaminants. (3) A space which is not intended for continuous employee occupancy. Generally, confined spaces can be categorized as those with open tops and a depth that will restrict natural air movement. Also, enclosed spaces with very limited openings for entry within confined spaces, mechanical devices, such as agitators and conveyors, present serious hazards because they could be inadvertently activated. Mechanical devices must be secured and proven to be de-energized before a confined space entry permit is issued.

Also, the atmosphere inside these spaces may present deficient oxygen due to the lack of air movement or the process, flammable vapors from previous contents, or toxic substances from previous contents.

The following are examples of confined spaces:

- a. Any closed or open top tank over four (4) feet deep.
- b. Tank car
- c. Tank vessels
- d. Tank truck
- e. Reaction vessel
- f. Hopper/bin
- g. Sewer
- h. Boiler
- i. Vaporizer
- j. Flue chamber
- k. Fire box
- l. Blender
- m. Pit in the earth

A confined space permit will be obtained for entry into a confined space. Permits shall be signed at the site of entry and not in areas isolated from the confined space. All persons signing the permit shall meet at the permit location together and assure all is safe for the required entry.

The confined space will be inspected jointly by the Hercules Fire/Safety Department, engineer in charge, operating department/building supervisor and the subcontractor. When all are satisfied that the work can be done safely, a confined space entry permit will be issued. This permit will be valid for only the time specified on the permit.

## Control of Confined Space Entry cont'd

The initial test of the atmosphere for confined space entry permit will be performed by the Hercules Fire/Safety Department. This will be done as part of the transfer of facilities to the subcontractor. Subsequent to that, all necessary tests must be performed by the subcontractor with their equipment.

The subcontractor is responsible for assuring safe working conditions for his employees. The following is an outline to be used for controlling entry into confined spaces:

1. Determine if the work can be performed without entry into the confined space. Entry should be made only if the work cannot be performed from the outside.
2. Personnel working in the confined space will be issued the permit.
3. Confined space entry permits are valid only for entry into confined spaces as outlined on the permit. No other entries shall be made, regardless of the proximity or similarity to the approved confined space permit.
4. Precautions and limitations must be listed on the permit. All personnel entering the confined space must fully understand and adhere to these precautions and limitations prior to entry.
5. The duration of the permit must not exceed that of the job or the employees workday, whichever is shorter.
6. The permit shall be posted at the point of entry into the confined space.
7. The supervisory personnel in charge of the confined space to be entered are responsible for preparing the confined space for entry before requesting signatures on the permit.
  - a. All inlet and outlet lines to tanks or vessels, except those of air and pure cold water, must be disconnected and blanked off before entry can be made (slip blinds are not acceptable).
  - b. Switches and mechanical equipment must be locked out before entering the confined space. The person(s) entering the confined space must maintain possession of the keys to the lockout devices. All de-energized equipment must be tested before entry.

## Control of Confined Space Entry cont'd

- c. All flammable, toxic, and corrosive materials must be removed from the confined space. When flammable gases are used in a confined space for welding or cutting, the bottles containing the gases will not be allowed in the confined space. The hoses containing gases shall be, if possible, of continuous length into the confined space without splices or couplings except at the torch connection. Proper air ventilation will be required to remove welding/cutting fumes.

Safety harnesses with lifeline must be worn by all persons entering a confined space. At all times, at least one (1) employee must be stationed outside of the confined space when work is being conducted inside the confined space. This person must be capable and equipped for rescue.

When portable electric lighting is used in a wet confined space or in electrically conductive tanks, vessels, and drums, the lighting shall be operated at a maximum of 12 volts to prevent potential electrocution of personnel in the event of an electrical fault. A ground fault interrupter circuit will be used in all confined spaces requiring electrical equipment.

When deficient oxygen atmosphere exists, proper ventilation will be provided by the subcontractor.

All subcontractors who will be doing confined space entries in the course of their contract are required to submit a written copy of their confined space program to the plant Safety Department prior to starting work. If at any time during a confined space entry it is found that an issued permit is being violated, this will be considered cause for the immediate revocation of the permit, and all personnel will be ordered from the confined space until the engineer in charge of the contract is notified. The permit will then be re-issued and the work will be allowed to continue.

The SFAAP Fire Department has been designated as the In Plant Rescue Team, they are to be notified of any confined space emergency immediately, so delay is avoided in response. They will assume complete control of the rescue effort.

## Electrical Lockout/Tagout

All equipment and energy sources shall be locked or tagged out when repairs are being made.

Where multiple craftsmen are involved, separate padlocks and keys must be independently maintained to avoid inadvertent activation of the circuit breaker or disconnect switch. The person(s) doing the work shall keep the keys to the locks while performing such work.

Electrical circuit(s) must be de-energized and locked out before the work can begin.

All mechanical apparatus must be blocked or locked out to prevent activation before work can proceed.

All extension cords and temporary wiring must meet requirements as set forth by the National Electrical Code (NEC). Extension cords must be checked before each use and damaged cords shall be repaired or replaced immediately. Protect extension cords and wiring from external sources, such as being walked or driven over, pinched in doors, cut or subject to impact.

Know the location of electrical circuits before beginning work, such as drilling, jackhammering or excavating to prevent accidental contact. (Underground electrical circuits are encapsulated in red concrete.)

Whenever using electrical hand tools in a damp environment a ground fault interrupter circuit shall be used.

Two persons must be present at all times when work is performed on 2400 volt and above systems (transformer substations, substation switch houses, overhead distribution lines, etc.). In an emergency, the second man would provide immediate help or place a call for assistance if necessary.

All subcontractors are required to follow OSHA guidelines for lockout/tagout. A violation of these rules will be cause for stopping the work immediately. The engineer in charge and the Safety Department will meet with the job superintendent prior to allowing the work to continue.

## Excavating and Trenching

Local, State, and Federal regulations shall be followed in all excavating operations. Before opening excavations, all utilities shall be located and identified. All excavations within five (5) feet of utilities shall be performed by hand excavation unless these utilities are being relocated and are disconnected (not in service.)

The walls and faces of trenches five (5) feet and deeper, and excavations that expose employees to danger from moving ground or cave-in shall be guarded by a shoring system, sloping the sides of the excavation to the angle of repose or by using equivalent means, meeting OSHA requirements, and approved by the Hercules Engineering Department or the Safety Department.

Trenches four (4) feet deep or more shall have adequate means of exit, such as ladders or steps located so that there is no more than twenty-five (25) feet of lateral movement.

In excavations that employees are required to enter, excavated or other material shall be stored and retained a minimum of at least two (2) feet from the edge of the excavation.

Daily inspections of excavations shall be made by the subcontractor superintendent. If evidence of possible cave-ins or slides is apparent, all work in the excavation shall cease until the necessary precautions have been taken to safeguard the employees. Additional inspections of excavations shall be made by the qualified subcontractor employee after every rainstorm or other disturbance to prevent and guard against slides and cave-ins.

Excavations and trenches must be adequately barricaded and identified. Warning devices must be placed by excavations and trenches to provide sufficient warning.

## Lifting and Material Handling Equipment

All lifting and material handling equipment shall be inspected annually by a competent person and meet OSHA requirements before entry is allowed onto Sunflower Army Ammunition Plant.

All lifting and material handling equipment shall have a properly operating fire extinguisher available for use.

Only authorized personnel shall be permitted to operate lifting and material handling equipment. All equipment shall be inspected prior to use each day.

Only one person should be designated to give hand signals to the crane operator. If the person giving hand signals cannot maintain visible contact with the crane operator then radio, telephone, or a visual and electrically operated audible system shall be used when the distance between the signal person and operator is more than one hundred (100) feet and visual contact cannot be maintained.

Cranes are not allowed to operate within ten (10) feet of overhead power distribution lines. (See chart below.) Assume every electrical line is energized.

Equipment cannot come within the following minimum clearance from energized overhead lines, or the equipment must be blocked to ensure that no part, including cables, come within the following minimum clearances:

<u>Power Line (KV)</u>	<u>Required Minimum Clearance (Feet)</u>
50 or under	10'
51-200	15'
201-300	25'
301-500	35'

A notice of the minimum required clearance shall be posted at the operating position of the equipment, legible at twelve (12) feet.

All outriggers must be down and on stable footings before making a lift. Vehicles used for transporting materials and personnel shall not be parked so as to obstruct access to and from the facilities except as required for unloading and loading of equipment and materials.

Never grease, oil, or service a crane while it is in operation. Cranes will not be allowed to operate with fuel or hydraulic leaks. All guards for gears, belts, shafts, exhaust systems, etc. shall be in place.

## Lifting and Material Handling Equipment cont'd

All loads must be properly rigged before the lift is allowed. Never perform a lift or swing a load over personnel. Riding material and crane hooks is strictly prohibited.

At any time personnel are to be lifted on a crane or other lifting device, a pre-lift inspection shall be performed by the subcontractor in accordance with CFR 29 Part 1926.550(9) of the equipment, and personnel protective devices that will be used.

## Ladders and Scaffolds

Ladders must be inspected before each use. Ladders with damaged/missing rungs or steps, damaged/split side rails, faulty or defective construction shall be removed from service and tagged defective.

Metal ladders shall not be used where there is a possibility of electrical contact. Job built ladders shall be constructed in compliance with OSHA Regulations.

The top of ladders shall extend at least thirty-six inches (36") above a landing when being used to gain access to platform and roofs.

All straight and extension ladders are to be equipped with nonslip feet. \*If the ladder cannot be properly positioned, secure it by external means or have someone man the base to steady the ladder.

Safety belts must be worn when working on straight or extension ladders when the work involves reaching, pushing, pulling, or action which may dislodge a person from the ladder. Stepladders over twelve (12) feet tall shall be held by a ladder tender or tied off at the top.

The top section of an extension ladder shall not be used separately as a straight ladder. Stepladders shall not be used as straight ladders.

The top step or platform of a step ladder shall not be used for standing. When climbing or descending ladders, employees shall face the ladder and use both hands for support. Always use both hands while climbing a ladder. Never carry unsecured equipment or tools while climbing or descending a ladder, use a rope to raise and lower equipment or tools.

All scaffolding must meet the requirements set forth by OSHA guidelines. All scaffolds must be erected on a firm, plumb foundation adequate to support the intended load. Bracing must be in place before loading takes place. Platforms must be planked solid. Top rails, mid-rails, and toe boards must be in place before work on the scaffold can proceed. All components of a scaffold must be inspected prior to use and defective parts removed from use. All scaffolding shall be secured to adjacent structures wherever possible.

\*Change 1 - 1/26/90

## Ladders and Scaffolds cont'd

Signs shall be provided on lower levels of scaffold stating "Danger - Overhead Work." Overhead protection shall be erected on scaffolds when there is a possibility of objects being dropped from above.

A ladder shall be used to gain access to the work platform unless the scaffold has a built-in ladder. Do not climb the bracing.

When working from a suspended scaffold, a safety harness must be worn at all times and the lifeline must be independent from the scaffold suspension.

Personnel working on the exterior of equipment or facilities, where a platform or scaffolding cannot be economically or practically installed, shall wear a safety harness secured to the structure.

## Floors, Wall Openings, and Stairways

Barricades shall be provided by the subcontractor for floor/roof openings, trenches, and excavations. Roof edge barricades shall be provided for personnel working on roofs.

All floor openings shall be protected with standard guardrails or covers that cannot be displaced.

All barricades shall meet OSHA height and side loading requirements.

Stairways shall be kept clear. Do not dispose of or store material in stairways. Materials shall not be dropped through a floor or wall opening without prior approval from the Hercules Safety Department. Stairways shall have well-braced handrails.

Guard railings removed for material handling shall be replaced immediately upon completion of the task.

Escape chutes are for emergency use only and are not intended for any other use. Do not store material in or around escape chutes.

## Hand and Power Tools

Inspect all tools before use. Defective tools shall be removed from service. Use tools that are designed for the particular task intended. Never use a tool for the wrong application, e.g., a crescent wrench to hammer a nail. Do not use tools with mushroomed heads, sloppy or loose connections, split, or broken handles.

Check all electrical tools for proper grounding. Make sure insulation is good and cords are not frayed. De-energize all machines and unplug all portable tools before making adjustments or attachment changes. Never remove guards or safety devices.

Air powered tools shall have safety pins, wires, or retainers on all connections. Compressed air shall not be used for the cleaning of clothing.

Portable power generators and welding machines must be internally grounded.

Tools, equipment and materials shall not be thrown from one employee to another nor dropped from one level to another. Transfer shall be from hand-to-hand or by handline.

When using woodworking machines or saws, use guards and push sticks when appropriate.

Inspect abrasive wheels for cracks, chips, or other defects before each use.

Suspend cords and hoses over aisles where they will not pose tripping hazards; if laid across floors, protect them with wooden strips or special raceways.

All electrical tools will be de-energized at the end of each workday.

Remember the four basic rules for hand tool safety.

- A. Select the right tool for the job.
- B. Keep tools in good condition.
- C. Use tools properly.
- D. Keep tools in a safe place.

## Personal Protective Equipment

Hercules has no obligation to provide protective clothing/equipment to the subcontractor unless the subcontract specifically so provides.

Personal protective equipment/clothing shall be inspected regularly and maintained in good condition. Unsafe and defective personal protective equipment/clothing shall not be used. Subcontractor personnel shall be trained in the proper care/use of personal protective equipment.

Hard hats meeting requirements of ANSI Z89.1 and Z89.2 are required for all operations at Sunflower Army Ammunition Plant. Bump caps are not permitted.

Proper eye and face protection meeting the requirements of ANSI Z87.1 are required for all operations or visiting the job site. Sunglasses are not accepted as a substitute for safety glasses. Proper shielding shall be provided by the welder operator to prevent exposure to operating and construction service personnel. Adequate warning signs shall be in place to warn personnel of the welding hazard.

Hearing protection shall be used meeting the requirements of ANSI Z24.22 when performing work that creates excessive noise. Excessive noise is defined as 84 dba or greater. Examples of tools/equipment requiring hearing protection include, but are not limited to, the following: jackhammer, impact wrench, chain saw, concrete/brick saw, steel cut-off saw, air chisel, lawn mowers, gasoline weed eaters, crane, dozer, rotary hammer drill, and air arch cutting.

Proper foot protection meeting the requirements of ANSI Z41.1 is required for all operations. Soft soled and tennis shoes even if approved by ANSI are not allowed.

Respiratory protection shall be used in areas as defined by the Hercules Safety Representative or when feasible engineering or administrative controls are not effective in controlling toxic substances. Respiratory protective devices shall be provided by the subcontractor and shall meet the requirements of ANSI Z88.2. Respirators shall protect against the specific contaminant to which the employee may be exposed.

Appropriate clothing must be worn on the job. Do not work without the protection of a shirt and long pants. Tank top, sleeveless shirts and shorts are not allowed.

14.3

**ATTACHMENT: First Aid Instructions for TVA Employees**

# **FIRST-AID INSTRUCTIONS**

**For  
TVA Employees**

**TENNESSEE VALLEY AUTHORITY**

**Division of Medical Services**

**1986**

**TVA/OCS/MS-86/1**

## ***Introduction***

The instructions in this booklet have been developed to assist TVA employees in using first aid measures safely and confidently, and to furnish them with specific information regarding the use of supplies available in TVA first-aid kits and first-aid rooms.

This material is not intended as a first-aid text, nor is it a substitute for first-aid training. It is a composite of simple procedures for handling some of the more common injuries and ailments encountered both on and off the job. Employees are encouraged to participate in first-aid training courses offered by TVA and to hold up-to-date first-aid certificates.

All first-aid treatment of injuries on the job, regardless of severity, must be reported according to the procedure described in the TVA Instruction under VIII INJURY, Employee.

First-aid kits, supplies, and refills for locations where there are medical offices or health stations (except Chattanooga) may be obtained on TVA form 9275 submitted to the local medical office or health station. At other locations, and at Chattanooga, storeroom requisitions (forms 9275) should be sent to the Medical Director.

Supplies for refills for first-aid kits also are available at project medical offices, steam plant health stations, and certain district and division offices of the Office of Power.

**REMEMBER THAT THE OBJECT OF FIRST AID IS TO MAKE THE PERSON MORE COMFORTABLE AND TO REDUCE THE CHANCE OF FURTHER INJURY OR DISABILITY. WHEN IN DOUBT ALWAYS REFER TO A PHYSICIAN.**

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## ABRASIONS AND SCRATCHES

Wash gently but thoroughly with soap and water.  
 Rinse with clean water.  
 Remove obvious foreign particles from the wound.  
 Apply antiseptic.  
 Apply sterile dressing.

## ACUTE ILLNESS

Headache, cough, chills, dizziness, nausea, vomiting, sore throat, or fever may be forerunners of a communicable or severe disease. They may also accompany exposures to various poisonous materials. If these symptoms are severe enough to cause complaint, medical advice should be sought. Other workers should be protected from exposure by isolating the sick worker until he can be seen by a physician.

## AMPUTATION

In case of partial or complete amputation every effort should be made to preserve the severed part. Hold it in position with a sterile compress and support with splint.  
 Control bleeding as quickly as possible.  
 Use a sterile compress to help control bleeding.  
 Use a tourniquet only if direct pressure and all other procedures to control bleeding fail.  
 Place a sterile dressing over all injured tissue.  
 Treat injured person for shock (See p. 13.)  
 Refer to physician immediately.

## ANIMAL BITES (INCLUDES BAT BITES)

Wash wound with soap and water to remove animal saliva.  
 Rinse well.  
 Apply sterile dressing.  
 Refer to physician.  
 Notify local health department.

### Caution:

*It is not necessary to kill domestic pets suspected of having rabies, except to protect others from danger. Such pets should be confined and observed for 10 days for such signs of rabies as changed behavior, excitability, salivation, paralysis, and death. Wild animals may not show clear signs of rabies and*  
 (Continued)

*should be killed for examination*

*If you have to kill a suspected animal, try not to damage its head*

*If you are bitten by an animal, always suspect it to be rabid until proved otherwise*

## ASPHYXIA (STOPPAGE OF BREATHING)

### *Common Cause:*

Obstruction of air passage to lungs as in choking, drowning, etc.

Paralysis of the respiratory center of brain as in electric shock.  
Interference with the oxygen-carrying function of red blood corpuscles as in carbon monoxide asphyxiation.  
Lack of oxygen in air breathed as in storage bins, mines, etc.

### *Treatment:*

Be sure person is in fresh air.

Start artificial respiration immediately. Follow instructions on pages 17-18.

Treat for shock (See p. 13.)

Call for help at once.

## BRUISES

A bruise is usually caused by a blow or fall. The skin is not broken but the tissues underneath are injured, resulting in broken small blood vessels. Pain, swelling, and black and blue colors appear.

### *Treatment:*

Immediately apply cloths wrung out in cold water or an icebag. If possible, elevate the injured part and place it at complete rest.

The general rule is "cold" applications for the first 24 hours followed by "heat."

If soreness or disability persists, refer patient to physician.

## BURNS AND SCALDS

### FIRST and SECOND DEGREE THERMAL BURN

Immerse burned area in a container of cold water, preferably 45-50° F. If the part cannot be immersed, apply cloths soaked in ice water and change the cold packs constantly.

Continue cold-water treatment until patient can stand removal without recurrence of pain.

Do not break blisters intentionally.

Treat the person for shock (see page 13.)

(Continued)

After cold-water treatment, cover burn area with sterile dressing.

Refer patient to physician.

### THIRD DEGREE THERMAL BURN

Cover with dry sterile dressing.

Treat for shock (see page 13.)

Leave blisters alone.

Refer to physician.

### CHEMICAL BURNS: (Acid or Alkali)

Flush burned area at least 15 minutes with large quantities of water (preferably lukewarm).

Cover with sterile dressing.

Refer patient to physician if burns are severe or extensive.

### CREOSOTE BURNS:

Use creosote burn wash found in TVA first-aid kits.

### ELECTRIC BURNS:

Should always be treated as severe burns, unless clearly of a minor nature.

### EYE BURNS: (See page 7.)

### SUNBURN:

Same treatment as for minor burn, if small area involved.

Severe or extensive cases should be referred to a physician.

## CARBON MONOXIDE POISONING

Remove victim to fresh air.

If breathing has stopped or comes in gasps, start artificial respiration (see page 17) and continue until natural breathing is restored or until the doctor pronounces person dead.

Keep victim warm and insist on complete rest until he is seen by a physician. Even slight exercise is dangerous.

Refer to a physician.

## CHEST AND ABDOMINAL INJURIES

Blows to the chest and abdomen may result in injury to underlying organs and tissues, even though no sign of injury may be seen.

(Continued)

#### *Treatment:*

Keep patient warm and quiet.

Do not move until transportation is arranged.

Cover open wounds with sterile dressings.

In case of suspected abdominal injury give nothing by mouth.

Refer to a physician.

## CHOKING

If the victim is breathing well with only partial obstruction and is still able to speak or cough effectively, do not interfere with his attempts to expel a foreign body. If the victim cannot speak or cough, uses a distress signal, appears blue, or shows an exaggerated effort to breathe, you must follow the procedures described below.

#### SITTING OR STANDING VICTIM

Stand behind the victim and wrap your arms around his waist. Place the thumb side of your fist against the victim's abdomen, slightly above the navel and below the xiphoid process (tip of the breastbone). Grasp your fist with your other hand and press it into the victim's abdomen with four quick upward thrusts.

#### SUPINE VICTIM

Place one of your hands on top of the other, with the heel of the bottom hand in the middle of the victim's abdomen, slightly above the navel and below the rib cage. Move forward so that your shoulders are directly over the victim's abdomen and press upward toward the diaphragm with four quick thrusts. Do not press to either side.

## COLD INJURY

#### CHILBLAINS

#### *Prevention*

Keep feet warm and dry.

Avoid standing for a long time without exercise.

#### *Treatment*

Immerse in warm, not hot, water.

Treat as a minor burn.

(Continued)

#### "TRENCH" FOOT:

After hours of exposure to low (but not freezing) temperature, feet become very painful. Swelling and numbness follow.

#### *Treatment:*

Keep patient off his feet. Use a stretcher to carry him to a physician.

Cover foot (or feet) with sterile dressing.

Do not allow victim to smoke.

#### FROST BITE:

Signs of frostbite are whiteness and numbness of the flesh; the skin feels cold to the touch.

#### *Treatment:*

For small areas such as the nose, ears, and other parts of the face, place warm palm of hand over area, but do not rub.

Frostbitten fingers: Warm directly against skin in armpit.

Frostbitten feet: Immerse in warm (but NOT hot) water.

Encourage gentle exercise of fingers and toes.

Don't expose to high temperature immediately.

Give victim a warm drink.

Handle frozen part with great care to avoid injury to it.

Refer to physician if injury is severe or extensive.

## COMMUNICABLE DISEASES

Communicable diseases are most catching in the early stages, even before rash and other signs appear. Therefore, if a worker knows he has been exposed to a communicable disease, he should take personal responsibility not to spread it. He should consult a physician immediately upon the onset of such warning signs as cough, sore throat, aching in joints and muscles, unusual tiredness, and the like.

## CONVULSIVE SEIZURE (EPILEPSY)

Insert, but do not force, a small piece of wood well wrapped with gauze or clean cloth between patient's teeth to keep him from biting his tongue.

Do not attempt to hold patient still. Protect him from injury as he thrashes about.

Give nothing by mouth.

Refer to physician.

## DERMATITIS (SKIN RASH)

Some skin diseases may be caused by things individuals come in contact with either on the job or elsewhere. Preventing contact with materials to which one is sensitive will help control skin rashes.

### *Prevention*

- Use engineering safeguards and protective clothing which have been recommended.
- Practice good housekeeping in your work area.
- Keep clean - personal cleanliness is the most important single factor in control of contact dermatitis.
- Dry hands well after washing.
- Do not use kerosene, gasoline, or carbon tetrachloride or other similar solvents for cleansing skin.
- Ointments and lotions may aggravate dermatitis unless such treatment is prescribed for specific conditions.
- Remove contaminated clothing as soon as possible.

### *Treatment*

- Refer to physician.

## DIABETIC EMERGENCIES

Unconsciousness is sometimes a complication in the person with diabetes. This may be of two types - one due to the disease and the other due to temporary accumulation in the body of too much insulin which has been used in the control of the disease.

In either case, the unconscious diabetic should be seen by a physician without delay.

Every diabetic should carry an identification card and should inform at least one of his fellow employees of his disease. Diabetics often complicate the healing of wounds. Injuries to the feet are especially troublesome and should be treated by a physician. All other injuries should be treated by a physician if healing does not take place promptly.

## DISLOCATIONS

The injured joint looks out of shape when compared with a similar joint, and there is pain and usually swelling. Many dislocations are also accompanied by broken bones. (Continued)

### *Treatment:*

- Do not attempt to put a dislocation back in place.
- Support dislocations in a comfortable manner.
- Treat for shock if necessary (See page 13.)
- Refer to physician.

## DROWNING

Make certain that air passages are not blocked.

Start artificial respiration at once, check for circulation, and continue resuscitation as needed until physician declares there is no further need, or until you become exhausted. (See pages 17 & 18.)

Treat for shock.

Send for physician.

When breathing is restored make sure he receives medical attention by a physician.

## EYES

**CHEMICAL BURNS: (Acid or Alkali)**

### *Treatment:*

Wash the eye freely with clean water. This may be done by immersing the face in pan or bowl of water, gently pulling back the lids, and moving the eye back and forth. Another way is to place the person on his back, hold his eyelids open with your fingers, and pour water into the inner corner of the eye from a pitcher or other container.

Continue this for at least 15 minutes.

Apply eye patch.

Refer to physician as soon as possible.

### *Caution:*

When work is being done in which there is a possibility of chemical burn, be sure there is plenty of clean water available.

### FOREIGN BODY:

*On Surface of the Eyeball:*

Do not try to remove.

Refer to physician.

*On Surface of the Membrane Lining the Eyelid:*

Pull the lower lid down gently and look for the speck.

(Continued)

Remove it with a corner of clean piece of gauze or a twist of cotton moistened with water.

If speck seems to be on the lining of the upper eyelid, grasp the lashes of the upper lid gently and draw the upper lid down over the lower lid. As the upper lid returns to its normal position, the foreign body may be caught on the lashes of the lower lid and removed by washing action.

If these measures fail, refer to a physician.

#### EYE INJURIES:

If the eye is injured by a foreign body like a splinter of glass, metal, or wood, or by a particle blown into it with great force, apply eye patch.

If there is a protruding foreign body, do not remove it but bandage both eyes, using great caution so that the foreign body is not driven into the eyeball.

If the eyelids and tissue around them are injured, apply a firm bandage to prevent movement of the lids.

Refer to a physician.

## Fainting

#### Precaution:

If a person says he feels as if he will faint, have him sit down and bend his body forward until his head is level with his knees. He should hold this position for a few minutes or lie down.

#### Treatment:

Place person on back with head lower than body.

Supply cool air.

Loosen clothing around neck and waist.

After consciousness returns, person should continue to lie quiet for a while before getting up.

If the faint lasts more than a few minutes the person should be referred to a physician.

## Fracture (Broken Bones)

#### Actual or Suspected Fracture:

Gentleness is more important than speed in handling the patient.

Keep injured part at rest by splinting and bandaging.

Keep person warm and quiet.

Refer to physician.

#### Compound Fracture:

If the bone shows through the skin, cover injured part with a sterile dressing. Control bleeding if present.

Do not disturb position of injured part.

Splint.

Treat for shock (See page 13.)

Refer to physician.

## Head Injury

#### Treatment:

Keep the person lying down.

Do not move the victim's head unless airway maintenance is necessary.

Treat any bleeding wound. (Bleeding from ears or nose may indicate serious injury. Do not attempt to treat.)

Keep patient warm and quiet.

Give nothing by mouth.

Refer to physician.

#### Caution:

If blow on head is hard enough to cause even momentary unconsciousness, refer to physician.

## Heat Cramps

Same treatment and preventive measures as for heat exhaustion (see below).

## Heat Exhaustion

This condition may occur during long heat waves or in locations where heavy work is done in high temperatures. The victim may show signs of shock and usually is conscious, pale, and cool.

#### Prevention:

Drink water often throughout the day. 1 glass at a time.

Wear working clothes that are light and porous to promote evaporation of perspiration. (Continued)

**Treatment:**

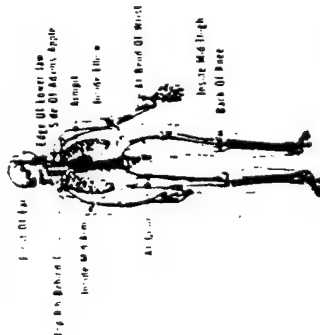
- Have person lie down in cool place with head lowered.
- Loosen his clothing.
- Cover body with light covering.
- If he is conscious give cool water.
- Refer to physician if symptoms do not disappear quickly.

**HEAT STROKE OR SUN STROKE**

Heat stroke is characterized by a flushed face and hot skin. Person often becomes unconscious. (See page 16.)

**Treatment:**

- Get person to a cool place. Elevate the upper part of the body.
- Remove as much clothing as is necessary to apply cold cloths to head and body.
- Continue applying cold cloths until consciousness returns or until body temperature returns to near normal.
- Watch for signs of shock and treat if necessary. (See page 13.)
- When person is conscious, give cool water.
- Give NO stimulants.
- Refer to a physician as quickly as possible.

**HEMORRHAGE (External Bleeding)****THE SEVERE ARTERIAL BLEEDING**

Expose wound to uncover the area of bleeding. For bleeding from injured tissue, apply a sterile bandage compress directly over the wound to form a pressure bandage.

For severe arterial bleeding apply finger pressure at appropriate pressure point, as shown at left, during the application of pressure bandages. Do not apply so tight as to act as a tourniquet.

Keep the person lying down and treat him for shock.

Use tourniquet **ONLY** when other control methods for bleeding have failed.

Refer to physician.

(Continued)

**TOURNIQUET WARNING:**

- Once the tourniquet has been applied leave it until a physician removes it.
- Make certain tourniquet is tight enough to stop bleeding.
- Do not apply dressing over tourniquet.
- A notation should be made and attached to the injured person giving the site of the tourniquet and time of application.

**INSECT BITES**

To relieve the discomfort caused by the bite or sting of bees, mosquitos, wasps, or flies, apply a Sting-Kill swab if a first-aid kit is available.

*Alternate procedure:* Apply weak ammonia water or a paste of baking soda and water.

If the stinger is left in the wound, withdraw it.

If swelling and pain persist, refer to a physician.

*Any individual with a history of being sensitive to insect bites should be sent to a physician immediately.*

**NOSEBLEED**

Have person sit quietly with head tilted slightly forward to prevent blood from accumulating in throat.

Loosen collar.

Wring out cloths wet with cold water and apply over nose, pressing the nostril on the bleeding side against the central portion of the nose for 4 or 5 minutes.

Instruct person not to blow nose for hour or two after bleeding has stopped.

Severe or repeated nosebleed requires medical attention.

**POISONS**

Identify the poison, estimate the amount taken, and save all containers to assist treatment. After initial emergency care has been given, get the victim to a hospital without delay.

Administer artificial respiration, if needed.

Keep victim warm and quiet.

Take other actions advised by Poison Control Center.

(Continued)

**DO NOT** induce vomiting *IF:*

- a) The victim has ingested strong corrosives which have burned the mouth and throat, or has ingested petroleum products (kerosene, gasoline);
- b) The victim is unconscious, semi-conscious, convulsing or has convulsed;
- c) The victim is pregnant; or
- d) The victim has severe heart disease.

In most other cases, prompt cleansing of the stomach through vomiting is indicated. Collect and save vomitus for hospital evaluation.

To induce vomiting, administer 1 tablespoon of syrup of ipecac followed by several glasses of warm water or soft drinks. (Vomiting is more effective if stomach is partially full.)

Vomiting usually begins in five to fifteen minutes. If syrup of ipecac is not available, vomiting may be induced by tickling the back of the victim's throat with a finger or the blunt end of a spoon, fork or knife.

Keep victim's head low and turned to side during vomiting to prevent his breathing in vomitus.

If victim is conscious but lips, mouth, and tongue ARE STAINED AND BURNED by corrosives, acid or alkali:

**Do NOT** force vomiting.

Dilute by having the victim drink a glass of water or milk if he is conscious and not having convulsions. Discontinue dilution if it makes him nauseated.

Refer to a hospital or physician without delay.

**POISONING FROM CONTAMINATED FOOD:***Prevention*

Keep lunch as cool as possible, out of sun and away from any heat source.

Be careful what you carry in lunch, particularly in hot weather.

Medical office personnel can advise you about this.

*Treatment*

Give lukewarm water by mouth to help flush out stomach.

Treat for shock. (See page 13.)

Refer to a physician.

## POISON IVY, POISON OAK, OR POISON SUMAC

*Prevention:*

- Be able to recognize plant and avoid contact with it.
- Wear long sleeves and trousers when there is a possibility of being exposed to the plant.
- After exposure, you may be able to prevent rash by washing the exposed skin with laundry soap and water and then applying rubbing alcohol.

*Treatment:*

- Wash thoroughly with soap and water.
- Apply calamine ointment or lotion or caladryl to itching area.
- If the eruption persists, spreads, or is severe, refer to a physician.

## PUNCTURE WOUNDS

*SLIGHT:*

Encourage bleeding by mild pressure.

Wash with soap and water.

Apply sterile dressing.

Check to see whether person has had tetanus immunization.

**SEVERE:** (Wound that penetrates into underlying tissues)

Control bleeding with sterile compress.

Apply sterile dressing.

Refer to physician for treatment. This type of injury can result in tetanus and other serious infection.

**NOTE:** Tetanus (lockjaw) immunization is available at all TVA medical offices and health stations. All employees should receive this protection and should carry immunization records with them to enable doctors treating injuries to know whether to give anti-toxin or "booster" shots of toxoid. Cooperating examining physicians, when requested on form TVA 424, will also give booster shots.

## SHOCK

**FOLLOWING INJURY:**

Control bleeding if present. (See page 10.)

Keep person comfortably warm.

(Continued)

Remove all foreign bodies from mouth.

Loosen tight clothing.

Place person in lying-down position with his feet higher than his head (except in chest injury or suspected head fracture).

Relieve pain as much as possible.

Give artificial respiration if indicated (See page 17.)

Refer to a physician.

#### ELECTRICAL SHOCK:

Break contact with electrical conductor, turn off switch if possible. If this cannot be done, stand on a folded dry coat or newspaper or a dry board. With one hand protected by several thicknesses of dry cloth or newspaper, or with a dry stick or pole, grasp a dry part of victim's clothing and drag him away from the conductor. It may be possible to push a live wire off the victim with a dry wooden stick, or to pull the victim off a live wire with a piece of dry rope or your belt looped over the foot or hand.

If victim is not breathing, start artificial respiration immediately and check for circulation. Continue resuscitation as needed until breathing is restored or until physician indicates no further need or until you become exhausted. (See pages 17-18.)

Call for physician.

After victim is revived, apply sterile dressing to burns.

Refer to a physician.

### SLIVERS AND SPLINTERS

If the sliver is near the surface and can be grasped with the forceps or fingers, remove and treat the wound as a puncture wound. (See page 13.)

If the skin is deeply punctured by a foreign object, tetanus may result. (See page 13.)

Do not attempt to remove deeply imbedded objects.

Refer to a physician.

### SNAKE BITE (Poisonous)

Treat as follows:

1. The victim should remain calm, avoid exertion, and do nothing which would stimulate blood circulation (no alcohol). (Continued)

2. Apply a constriction band two or three inches above the bite (between the bite and the heart) just tight enough to insert a finger beneath it. This band should not stop blood flow. This band should be left in place until medical help is obtained.
3. Wash the area around the fang marks with soap and water and gently squeeze any blood or venom from the wound that might be present.
4. Do not cut the skin or apply ice.

Snake antivenom is one of the most effective treatments for snakebites when administered by qualified professional personnel. However, there is considerable risk of severe allergic reactions to the drug and its use by lay personnel is not recommended.

### SPRAINS

Occur when ligaments supporting a joint or connecting bones are torn.

#### Treatment:

Elevate the injured part and apply cloths wrung out in cold water or an ice pack.

A firm cravat bandage made from a triangular bandage is useful in supporting the injured part until it can be examined by a physician.

If in any doubt as to the extent of the injury, treat it as a fracture.

Refer to a physician.

### STRAINS

Occur when muscle fibers are torn.

#### Prevention:

Proper lifting and use of body mechanics.

Get assistance in moving heavy weights.

#### Treatment:

Put injured part at rest.

Apply cloths wrung out in hot water.

Refer to a physician.

## TOOTH AND MOUTH INJURIES

### FRACTURED JAW:

- Gently place the jaw in position so that the upper and lower teeth are together.
- Stabilize jaw by supporting with a triangular bandage tied at the top of the head.
- Remove gauze if patient has any breathing difficulty or becomes nauseated or unconscious.
- Apply ice pack to affected side to control swelling and pain.
- Give available medication for severe pain.
- Refer to physician or hospital.

### FRACTURED AND INJURED TEETH:

- Isolate fractured or loose teeth with gauze pads.
- Close teeth to hold in place.
- Give available medication for pain.
- Refer to dentist.

### FRUITFULS TO TEETH INSIDE MOUTH:

- Use standard methods for controlling bleeding as indicated by nature of wound. Wrap index finger in sterile gauze, apply direct pressure. Use cold packs for bruised lips.
- Bleeding from recent extraction site:
  - Place several layers of 2" gauze over bleeding site.
  - Close teeth firmly together to apply pressure for 10-15 minutes; repeat as necessary.
  - Refer to dentist.

### TOOTHACHE:

- Give available medication for pain.
- Do not place aspirin or other medication that is designed for ingestion on the tooth or gum.
- Refer to physician.

## UNCONSCIOUSNESS

Unconsciousness may be caused by a number of things such as heart failure, stroke, diabetic coma or insulin shock, epilepsy, excessive drinking, inhalation of toxic gases, head injuries, internal hemorrhage, etc.

Any unconscious person, except a person who has a head or neck injury, should have his neck lifted and his head tilted backward.

(Continued)

as in figure 2, page 17. If unconsciousness is due to a head injury the airway can be opened by thrusting the lower jaw forward into a jutting out position, the jaw thrust method. (Figure A, page 17).



(Figure A)

## CARDIOPULMONARY RESUSCITATION

1. DETERMINE IF VICTIM IS UNCONSCIOUS: Tap or gently shake victim's shoulder and shout - "Are you O.K.?" Call out - "Help!"
2. OPEN AIRWAY: Place one hand beneath the victim's neck and the other hand on the forehead. Gently lift the neck while pressing firmly on the forehead. This should open the airway. Place your ear near the victim's mouth and nose. LOOK at the chest for movement, LISTEN for breaths and FEEL for breathing against your cheek. If the victim is not breathing you should proceed to the next step.



(Figure 1)



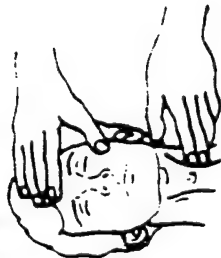
(Figure 2)



(Figure 3)

3. GIVE FOUR QUICK FULL BREATHS - Keep the head tilted and pinch the nose.

(Continued)



(Figure 4)

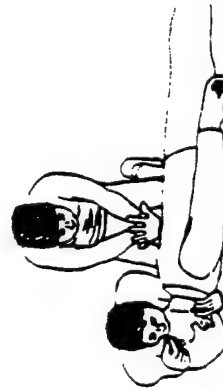
4. **CHECK FOR PULSE:** While keeping the head tilted with pressure on the forehead check the pulse for at least 5 seconds but no more than 10 seconds. Place your finger tips on the Adam's apple and slide your fingers into the groove at the side of the neck nearest you. If there is a pulse but no breathing give one breath every 5 seconds. If there is no pulse or breathing send someone to call an ambulance.

5. **FIND THE CORRECT HAND POSITION FOR CHEST COMPRESSIONS**  
With your middle and index fingers trace the rib cage to the notch where the ribs and breastbone meet. Place the middle finger on the notch and the index finger next to it. Put the heel of other hand on the breastbone next to your fingers. Put the first hand on the top of the hand on the breastbone. Keep your fingers off the chest.



(Figure 5)

6. **PUSH 15 - BREATHE 2**  
Give 15 compressions at a rate of 80 per minute. Tilt the head and give 2 quick full breaths. Continue to repeat 15 compressions followed by 2 compressions. Check the pulse and breathing after 1 minute and every few minutes thereafter.



(Figure 6)

## FIRST-AID KITS AND SUPPLIES

### FIRST-AID KITS

TVA  
Stock No.

11375  
11370

First Aid Kit, 16-unit size (filled)  
First Aid Case for 24 unit kit (empty)  
(Order contents extra. This kit is for use only on heavy duty line maintenance trucks.)

### SUPPLIES FOR FIRST-AID KIT

Item	TVA Stock Number	Number of Packages to 16-Unit Size	Number of Packages to 24-Unit Size
Bandage, compress, Telfa, 3 in., 2 per unit	11290	1	1
Bandage, gauze, 4 in. x 6 yds.	11240	1	1
Bandage, triangular, 40 in. wide	11160	2	2
Blanket, rescue, 56 in. x 84 in.	11392	0	1
Calomine ointment, 1/8 oz. tube, pkg. of 6 tubes	11120	1	1
Cold Pack	11220	1	1
Compress, 24 in. x 72 in.	11250	1	2
Compress, plastic, Telfa, 16 to pkg.	11210	2	3
Cresote burn wash, 6 vials per unit	11050	0	1
Eye dressing kit, 1 oz. bottle eye wash solution, 2 eye dressing pads, 2 sets adhesive strips	11260	1	1
Forceps and scissors	11230	1	1
Plaster, adhesive, 1/2 in. x 2-1/2 yds., 2 spools per pkg.	11270	1	1
Soap, anti-bacterial	34405	0	1
Swabs, Betadine (Povidone-iodine), 10 per unit	11060	1	2
Swabs, Sting-kill, 10 per box	11130	1	2
First-Aid Instructions Handbook	11090	1	1

14.4

ATTACHMENT: DA Form 285 (Jan 92) - U.S. Army Accident Report

# U.S. ARMY ACCIDENT REPORT INSTRUCTIONS

**General.** The unit having the accident must investigate it and complete this report. Complete shaded portions only for: Military on-duty, off-duty accidents; and military on-duty accidents resulting in less than 20 lost workdays. Accidents involving 20 or more lost workdays and/or total property damage of \$2,000 or more will require completion of the entire report. Type or legibly print the report. Items may be continued on a blank sheet of paper and attached to the report. Items listed below are keyed to the block numbers of DA Form 285, May 91. Items not listed here are self explanatory. Specific questions concerning this form should be referred to the local safety office.

## SECTION A - Accident Information

**Note:** This section should be completed for the initial report and for any changes to a previously submitted report.

1. Check "INITIAL" if this is the first report on the accident. Check "CHANGE" if this report is a change to a previously submitted report of the accident.
2. Enter the 6-digit Unit Identification Code (UIC) for the unit responsible for the accident (e.g., WXXXXX).
3. Provide military unit information for the unit listed in Block 2.
  - a. Full military address (e.g., C Troop, 17 Cavalry, Ft Bragg, NC 12345-6789).
  - b. Provide the unit branch (e.g., Armor Infantry Transportation).
4. Enter the year, month, and day of the accident (e.g., 90 11 07 (7 November 1990)).
5. Enter the military time the accident occurred (e.g., 0815, 2300).

6. Check either item a or b, depending on the location of the accident.

a. If item a is checked, state name of post or installation (e.g., Ft Bragg, NC; Federal Center, Atlanta, GA; Ft Hood, TX; Shaw AFB, SC).

b. Check item a if accident occurred in a theater of hostile fire or enemy action, but not as a result of such fire/action. This includes direct preparation for combat, actual combat, or redeployment from a combat theater.

7. Check "Yes" if explosives (C-4, TNT), ammunition, or pyrotechnics were involved and explain in Block 63 its involvement and specify the National Stock Number (NSN).

8. Give enough detail to find the exact location of the accident (e.g., building number, street or highway name, state and/or country). Also state the type of location (e.g., road intersection, tank trail, family housing, firing range).

## SECTION B - Personnel Information

**Note:** Complete this section for each individual involved and/or injured in the accident. "Involved" means any person who was injured, or who took actions, or made decisions which caused or contributed to the accident. If more than one person was involved, enter information on one person on the initial form and complete only Sections A and B on additional forms for others. Staple all forms together.

9. Enter individual's rank/grade (e.g., SS/SGT, CPT, GS-11, WG-8). Complete for all government personnel.

10. Enter individual's full MOS/Job Series (e.g., 65520, 11B40, GS-301).

11. Provide individual's full Military address for government personnel. If this address is not same as that in Block 3a, provide the unit.

12. State how many continuous hours without sleep this individual was on-duty prior to the accident.

13. Indicate how many hours of continuous sleep this individual had in the past 24 hours.

14. State the estimated number of days this individual will be away from work (totally unable to perform any work, but residing quarters). Does not include days hospitalized.

15. State the estimated (or actual) number of days this individual is hospitalized (inpatient/outpatient) receiving treatment. Days hospitalized for "observation only" are not reported.

16. State the estimated number of days this individual will not be able to perform his or her regular duties (light duty, profile).

17. Check appropriate block. If more than one applies, check the most severe.

18. For this individual's "most severe injury," check the appropriate block(s) (no more than 3), that indicate the cause of the injury.

19. Number the body part(s) most seriously injured (no more than 3) in their order of injury (the most serious first). Be as specific as possible.

20. For each body part numbered in block 19, place a corresponding number to indicate the type of injury received (select only the most serious).

21. Check the appropriate block that best describes the individual's action at the time of the accident. If Block 31gg is checked, complete Blocks 76 and 77 of Section H, as indicated by those instructions.

22. Provide a short but detailed explanation of the item checked in Block 31.

**Note:** For this report, the following definitions apply:

**Tactical Training** - Training in a field environment that uses or develops combat or combat support skills.

**Field Exercise and Tactical Training** - This begins when the individual reports to his or her primary duty location for movement to the field site and ends when he or she arrives back at the primary duty location from the field.

23. Check "Yes" if activity listed in Block 31 was part of a field exercise. State name of exercise if it has a name (e.g., Team Spirit, Reforger).

24. If vision enhancement device(s) were used, specify type and model number(s), and whether they caused the accident (e.g., Night Vision Goggles AN/PVS5A).

25. Provide standard or reference (Soldier's Manual, AP, TM, etc.) if it exists, that covers performance of the activity identified in Block 31.

26. Provide a simple explanation of the mistake(s) or how the activity or task was performed incorrectly (e.g., SGT Smith improperly backed his M915 truck without a ground guide).

27. In your opinion, why was the mistake made or the activity performed incorrectly? Check the most important reason.

28. Check the block corresponding to the piece of equipment associated with the person in Block 12 (e.g., SGT Adams was driving the "at-fault" M915, his name will be in Block 12 and his vehicle will be item 3 in Section C below).

## SECTION C - Property/Material Involved

Complete Blocks 52-59 on each piece of property or item of equipment involved in the accident (whether damaged or not). Include Army and non-Army, as well as equipment whose use or misuse contributed to the accident. Include up to 3 items of equipment on the initial form. Use additional blank sheets of paper for other equipment if necessary, continuing letter sequence (e.g., A, B, C, D, and E).

52. Type of equipment (e.g., sedan, truck, generator).

53. Full military equipment model number or civilian make (e.g., M109A2, M60A2, Ford, etc.).

54. Estimated cost of damage (ECOD) or actual cost of damage (ACOD), for each piece of property, which includes costs of parts and labor.

57. Indicate if this specific item was being loaned at the time of the accident.

58. If Block 57 is "yes", indicate which item was going the following.

60. Complete for each component or part whose failure or malfunction contributed to the accident. Include the EIR/QDR number in Block 60e.

61. Indicate how and why each component or part failed or malfunctioned by sketching from the lists provided and entering the appropriate number in the blocks provided.

## SECTION D - Environmental Conditions Involved

62. Check the environmental conditions present at the time of the accident (no more than 3), by checking appropriate blocks, whether contributing to the accident or not. Also check whether they caused or contributed to the accident.

## SECTION E - Accident Description/Narrative

63. Fully describe the sequence of events that lead up to and caused the accident. Explain how and why the accident occurred. Also include information required from Blocks 10 and 41.

## SECTION F - Corrective Action and Command Review

**Note:** The level of command review (Company, Battalion, Division, etc.) is determined by either the major Army command (MACOM) or installation policy.

65. Fully describe all actions taken, planned, or recommended to eliminate the cause(s) of this accident. Actions should be identified as appropriate at unit level and all the way up to HQDA level.

## SECTION G - SAFETY OFFICE USE ONLY

71. MACOM responsible for this accident (FORSCOM, TRADOC, etc.).

## SECTION H - Special Interest/Supplemental Information

This section is for use by the U.S. Army Safety Center, MACOMs, or interested safety offices to obtain additional Special Interest/Supplemental information on this accident as needed (e.g., AT tank fires, tactical parachute accidents, etc.). Blocks 76 and 77 have been designated for collection of supplemental information on parachuting accidents.

Blocks 76 and 77. If Block 31gg was checked, provide the following supplemental information for each individual.

- a. Name of jumper.
- b. Jumper height.
- c. Jumper weight.
- d. Type of jump (static line, non-tactical, static line, mass technical, freefall, non-tactical, freefall, tactical).
- e. Type of parachute and model.
- f. Jumper's equipment (list).
- g. Weight of equipment.
- h. Wind direction and speed at:
  - (1) Jump height.
  - (2) Drop zone.
  - Jump altitude.
  - Jumper's position in stick and exit.
- i. Time pre-jump conducted.
- j. Date of last jump and type of jump.
- k. Number of previous jumps.
- l. Date graduated from basic airborne training (year and month).
- m. Type of aircraft.
- n. Accident cause(s). Improper exit, static line injury, broken static line, parachute malfunction, entanglement, lost or stuck, air oscillation, unstable position, dropped on DZ area.

# U.S. ARMY ACCIDENT REPORT

FOR USASG USE ONLY

Requirement Control Symbol  
CSOCS-308

## SECTION A - ACCIDENT INFORMATION

1. CHECK ONE <input type="checkbox"/> a. INITIAL <input type="checkbox"/> b. CHANGE		2. UIC (Unit Identification Code) (6-Digit Code of Unit Having Accident)	3. UNIT NAME AND MILITARY ADDRESS	2b. BRANCH (Army, Air Force, etc.)
4. DATE OF ACCIDENT a. YR    b. MO.    c. DAY	5. TIME OF ACCIDENT (Local Military Time)	6. PERIOD OF DAY (Check one) <input type="checkbox"/> a. Day <input type="checkbox"/> b. Night	7. ACCIDENT OCCURRED (Check one) <input type="checkbox"/> a. On Post <input type="checkbox"/> b. Off Post	8. IF ON POST, NAME OF INSTALLATION/FACILITY
9. ACCIDENT OCCURRED DURING (Check one) <input type="checkbox"/> a. Combat <input type="checkbox"/> b. Non-Combat		10. WERE EXPLOSIVES OR AMMUNITION INVOLVED OR PRESENT? <input type="checkbox"/> Yes (See instruction Book) <input type="checkbox"/> No		
11. EXACT LOCATION OF ACCIDENT (Detailed enough to locate area) (State time of location)				

## SECTION B - PERSONNEL INFORMATION

12. NAME (Last, first, MI)		13. SOCIAL SECURITY NUMBER (SSAN)		14. AGE	15. SEX (Check one) <input type="checkbox"/> a. Male <input type="checkbox"/> b. Female	16. RANK OR GRADE	17. MOS OR JOB SERIES	27. CLASSIFICATION AT TIME OF ACCIDENT (Check one) <input type="checkbox"/> a. Active Army <input type="checkbox"/> b. Army Civilian <input type="checkbox"/> c. Army Contractor <input type="checkbox"/> d. Nonappropriated Fund (NAF) <input type="checkbox"/> e. Other U.S. Military <input type="checkbox"/> f. ROTC <input type="checkbox"/> g. Dependent <input type="checkbox"/> h. NGB Tech <input type="checkbox"/> i. NGB IOT <input type="checkbox"/> j. NGB AT <input type="checkbox"/> k. NGB ADSW <input type="checkbox"/> l. NGB AGR <input type="checkbox"/> m. NGB ADT <input type="checkbox"/> n. USAR IOT <input type="checkbox"/> o. USAR AT <input type="checkbox"/> p. USAR ADT <input type="checkbox"/> q. USAR FTM <input type="checkbox"/> r. Foreign Nat. Direct Hire <input type="checkbox"/> s. Foreign Nat. Indirect Hire <input type="checkbox"/> t. Foreign Nat. KATUSA <input type="checkbox"/> u. Foreign Nat. Attached to the U.S. Army <input type="checkbox"/> v. Public <input type="checkbox"/> w. Not reported	28. CAUSE OF ILLNESS/OCCUPATIONAL ILLNESS (Check one most serious) <input type="checkbox"/> a. Struck Against <input type="checkbox"/> b. Struck By <input type="checkbox"/> c. Fell from Elevation <input type="checkbox"/> d. Fell from Same Level <input type="checkbox"/> e. Caught in/Under Between <input type="checkbox"/> f. Rubbed/struck <input type="checkbox"/> g. Bodily Reaction <input type="checkbox"/> h. Overexertion <input type="checkbox"/> i. Exposure <input type="checkbox"/> j. External Contact <input type="checkbox"/> k. Injured <input type="checkbox"/> l. Inhaled										
18. ADDRESS (Use Official Address for all Military or Government Personnel (if different than block 3, add UIC))		19. DUTY STATUS AT TIME OF ACCIDENT (Check one) <input type="checkbox"/> a. On Duty <input type="checkbox"/> b. Off Duty		20. FLIGHT STATUS (Check one) <input type="checkbox"/> a. Yes <input type="checkbox"/> b. No		21. CONTINUOUS DUTY (hrs) (Without sleep)		22. HRS SLEEP IN LAST 24		23. DAYS LOST (Est. no. of days off from work; no counting day of injury; see remark quarters.)		24. DAYS HOSPITALIZED (Est. no. of days hospitalized receiving treatment; not for observation only)		25. DAYS OF RESTRICTED WORK ACTIVITY (Est. number of days person cannot perform regular duties; light duty/limited)		26. SEVERITY OF ILLNESS/INJURY (Check One) <input type="checkbox"/> a. FATAL <input type="checkbox"/> b. Permanent Total Disability. Person can never again do similar work. <input type="checkbox"/> c. Permanent Partial Disability. Person loses or can never again use a body part. <input type="checkbox"/> d. Days away from work. Person misses one or more workdays, but returns quarters. <input type="checkbox"/> e. Restricted Work Activity. Person is temporarily unable to perform regular duties; light duty/limited. <input type="checkbox"/> f. First Aid Only. Person has one-time treatment of minor injury (no lost work days). <input type="checkbox"/> g. No injury.		29. BODY PART(S) AFFECTED (Check one or more than 3) <input type="checkbox"/> a. Body (General) <input type="checkbox"/> b. Head <input type="checkbox"/> c. Forehead <input type="checkbox"/> d. Eyes <input type="checkbox"/> e. Nose <input type="checkbox"/> f. Jaw <input type="checkbox"/> g. Neck <input type="checkbox"/> h. Trunk <input type="checkbox"/> i. Chest <input type="checkbox"/> j. Heart <input type="checkbox"/> k. Back <input type="checkbox"/> l. Shoulder <input type="checkbox"/> m. Arm <input type="checkbox"/> n. Wrist <input type="checkbox"/> o. Hand <input type="checkbox"/> p. Fingers <input type="checkbox"/> q. Leg <input type="checkbox"/> r. Knee <input type="checkbox"/> s. Ankle <input type="checkbox"/> t. Foot <input type="checkbox"/> u. Toes <input type="checkbox"/> v. OTHER (Specify)	
30. TYPE OF INJURY/ILLNESS (Check one most serious) <input type="checkbox"/> a. Burns (Chemical) <input type="checkbox"/> b. Burns (Thermal) <input type="checkbox"/> c. Amputation <input type="checkbox"/> d. Decompression sickness <input type="checkbox"/> e. Asphyxiation (Suffocation) <input type="checkbox"/> f. Fractures <input type="checkbox"/> g. Dislocation <input type="checkbox"/> h. Abrasions <input type="checkbox"/> i. Concussion <input type="checkbox"/> j. Sprain/Strain <input type="checkbox"/> k. Cuts/Lacerations <input type="checkbox"/> l. Contusion <input type="checkbox"/> m. Puncture Wound <input type="checkbox"/> n. Hemorrhage/Rupture <input type="checkbox"/> o. Frostbite <input type="checkbox"/> p. Heat Stroke <input type="checkbox"/> q. Heat Exhaustion <input type="checkbox"/> r. Noise Induced Hearing Loss																			

# SECTION B - PERSONNEL INFORMATION (Continued)

48. Time licensed on this vehicle (Check one)		49. Total ADW driving mileage (Check one)		50. Total time in unit (Check one)	
a. Less than one year		a. Less than 1,000 miles		a. Less than 6 months	
b. One to two years		b. 1,000 - 5,000 miles		b. 6 months - 1 year	
c. Over two years		c. 5,000 - 10,000 miles		c. Over one year	
d. Unlicensed		d. Over 10,000 miles			

51. WHICH ITEM FROM SECTION C APPLIES TO THE INDIVIDUAL NAMED IN BLOCK 12? (This is needed in order to relate the person in block 12 to the equipment/vehicle below.)

☐ Item A    ☐ Item B    ☐ Item C    ☐ OTHER (Specify)

## SECTION C - PROPERTY/MATERIAL INVOLVED (Whether Damaged or Not)

	ITEM A	ITEM B	ITEM C
52. Title of item			
53. Model number			
54. Ownership (DDO OR POV UNIT PERSON)			
55. Dollar cost of damage			
56. Rollover protection system installed?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
57. Was this item being towed?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> NA
58. If towed, enter letter for item being towed			
59. Types of collision codes (Pick up to three from list below and enter in blocks.) (in sequence)			

### Types of Collisions

- |  |   |
|--|---|
| 1. Going forward and collided with moving vehicle        | 7. Ran off the road                             |
| 2. Going forward and collided with parked vehicle        | 8. Jackknifed                                   |
| 3. Collision while backing                               | 9. Going forward and rear-ended moving vehicle  |
| 4. Collision with pedestrian                             | 10. Going forward and rear-ended parked vehicle |
| 5. Collision with object (other than vehicle/pedestrian) | 11. Collision while turning                     |
| 6. Overturned  | 12. Other (Specify)                             |

60. Component/Part that Failed/Malfunctioned (Complete this section if a material failure/malfunction caused/contributed to the accident.)

	ITEM A	ITEM B	ITEM C
a. National Stock Number			
b. Part Number			
c. Describe Part			
d. Manufacturer's Identification Code			
e. EIR/QDR Number			

61. How/Why Part Malfunctioned (Select code from "How" list below and enter in first block. Select code from "Why" list and enter in second block.)

HOW WHY HOW WHY HOW WHY

### How Part Failed/Malfunctioned Codes

- |                               |                              |
|-------------------------------|------------------------------|
| 1. Overheated/burned/smelled  | 9. Twisted/torqued           |
| 2. Froze (temperature)        | 10. Compressed/malfunctioned |
| 3. Obstructed/pinched/clogged | 11. Bent/warped              |
| 4. Jammed                     | 12. Sheared/cut              |
| 5. Rubbed/worn/irrev          | 13. Decayed/decomposed       |
| 6. Corroded/rusted/pitted     | 14. Exposed current action   |
| 7. Overpressured/burst        | 15. Unknown/Other            |
| 8. Pulled/stretched           | Blank - Not reported         |

### Why Part Failed/Malfunctioned Codes

- |  |
|--|
| 1. Improper equipment design                   |
| 2. Inadequate maintenance                      |
| 3. Inadequate manufacture of equipment         |
| 4. Inadequate written procedures (AR, TM, SOP) |
| 5. Improper supervision                        |
| 6. Unknown                                     |
| 7. Other (Specify in narrative)                |

# SECTION B - PERSONNEL INFORMATION (Continued)

31. Person's activities at time of accident (Check one and one repeat in block 32.)

a. Submarine	j. Maintenance/Experiment	k. Fabricating	33. Hoisting
b. Combat Soldier	l. Education	l. Handling Material/Passengers	34. Passenger
c. Physical Training	m. Maintenance and Arts	m. Juniority/Responsibility/Grading/Receiving	35. Human movement
d. Weapons Firm	n. Food and Drug Inspection	n. Food/Drink Preparation	36. Maintenance
e. Engineering or Construction	o. Laundry/Dry Cleaning Services	o. Personnel Hygiene/Food/Drink Consumption/Shopping	37. Overhead/Underground
f. Communications	p. Pest/Plant Control	p. Supervisory	38. Personnel (See instructions)
g. Security/Law Enforcement	q. Operating Vehicle or Vessel	q. Office	
h. Fire Fighting	r. Handling Animals	r. Counseling/Advisory	
i. Patient Care (Paramedic)	s. Maintenance/Repair/Service	s. Sports	

32. SPECIFIC DESCRIPTION OF ACTIVITY/TASK

33. ON FIELD EXERCISE (Check one) <input type="checkbox"/> a. Yes (If YES, SPECIFY NAME OF EXERCISE) <input type="checkbox"/> b. No	34. ACTIVITY PART OF TACTICAL TRAINING? (Check one) <input type="checkbox"/> a. Yes <input type="checkbox"/> b. No	35. Type of training facility being used (Check one) a. Garrison b. Local training area c. Main training area d. NTC e. JATC f. CMTC g. Std. range facility live fire h. Other (Specify)
---	--	--

36. Type of training participating in at the time of accident (Check one)

a. School (Specify)	
b. Unit (1) Platoon (2) Crew (3) Individual	
c. On-the-job training	d. Other (Specify)

37. Last time individual received training prior to accident on activity specified in block 317 (Check one)

a. 0 - 3 months	b. 1 - 2 years
c. 3 - 6 months	d. More than 2 years
e. 6 - 9 months	f. Never
g. 9 - 12 months	h. Not applicable

38. Required protective equipment

CHECK APPROPRIATE BLOCK(S)	AVAILABLE?		USED?		N/A
	YES	NO	YES	NO	
a. Seat belt					
b. Helmet					
c. Goggles/glasses					
d. Gloves					
e. Ear plugs					
f. Other (Specify)					

39. INDIVIDUAL LICENSED TO OPERATE VEHICLE/EQUIPMENT? (Check one)

☐ a. Yes ☐ b. No ☐ c. N/A

40. DID ALCOHOL CAUSE/CONTRIBUTE TO THIS ACCIDENT? (Check one)

☐ a. Yes ☐ b. No ☐ c. Unknown

41. If drugs caused/contributed to this accident, check appropriate block.

a. Prescription	b. Illegal	c. Over-the-counter	d. None
-----------------	------------	---------------------	---------

42. Were vision enhancement devices being used? (Check appropriate block.)

a. Yes (Specify type/model in c and d)	b. No
c. TYPE	d. MODEL

43. Standard/Reference covering activity/task

a. Soldier's Manual (Task No.)	
b. CTT (Task No.)	
c. AR/TM/FM (Specify)	
d. SOP	e. None (Go to block 45.)

44. WAS ACTIVITY/TASK PERFORMED IAW STANDARD/REFERENCE? (Check one)

☐ a. Yes ☐ b. No (If NO, complete blocks 45-47)

45. DID INDIVIDUAL MAKE A MISTAKE? (Check one)

☐ a. Yes (If YES, complete blocks 45-47) ☐ b. No

46. What was the mistake? How was the activity/task performed incorrectly? (Explain below.)

47. Why was mistake/ineffectively performed incorrectly? (Check the most important reason and specify in block 48.)

a. Inadequate school training (contingency)	b. In a hurry	c. Inadequate services
d. Inadequate unit training (contingency)	e. Poor attitude	f. Inadequate equipment design
g. Inadequate on-the-job training (contingency)	h. Lack of resources	i. Inadequate written procedures (AR, TM, SOP)
j. Field deficiencies	k. Effects of environment	l. Inadequate supervision
m. Overconfidence in own/other's abilities	n. Inadequate technique	o. Other (Specify in narrative)

## SECTION D - ENVIRONMENTAL CONDITIONS INVOLVED

62. Environmental conditions. (Check environmental conditions present and indicate if condition caused/contributed to the accident.)

PRESENT	CAUSED/CONTRIBUTED	CONDITION	PRESENT	CAUSED/CONTRIBUTED	CONDITION
		1. Density visibility unknown			1. Wind gust/turbulence
		2. Fog, haze			2. Visible, gusting seas, swell
		3. Dark rain			3. Radiation (solar) sunlight
		4. Low cloud/visibility			4. Other factors (fog, rained, lightning)
		5. Fast, rain, sleet, hail			5. Normal/stress
		6. Snow, ice			6. Sinking (not due to precipitation)
		7. Dust, fumes, gases, smoke, vapors			7. Air pressure (downs, decompression, altitude, hypoxia)
		8. Noise, bang, static			8. Lightning, static electricity, ground
		9. Temperature/humidity (cold, heat)			9. OTHER (Specify)
		10. Storm, hurricane, tornado			

## SECTION E - ACCIDENT DESCRIPTION/NARRATIVE (From blocks 10, 47)

63. GIVE THE SEQUENCE OF EVENTS THAT AMPLIFY/EXPLAIN WHAT HAPPENED, LEADING UP TO AND INCLUDING THE ACCIDENT. (Explain why accident happened.)

64a. PRINTED/TYPED NAME OF PERSON COMPLETING THIS REPORT

64b. RANK

64c. TITLE

SIGNATURE

64d. DATE OF SIGNATURE  
(MM/DD/YY)

64e. TELEPHONE NO.

# SECTION F - CORRECTIVE ACTION AND COMMAND REVIEW

65. DESCRIBE THE ACTIONS TAKEN, PLANNED, OR RECOMMENDED TO ELIMINATE THE CAUSE(S) OF THIS ACCIDENT (from unit report up to 1000).

66a. PRINTED/TYPED NAME OF COMMANDER

66b. RANK

66c. SIGNATURE

66d. DATE OF SIGNATURE  
(YY/MM/DD)

66e. TELEPHONE NO.

a. TYPED NAME

b. SIGNATURE

c. TITLE

d. RANK / DATE

67

68

## SECTION G - SAFETY OFFICE USE ONLY

70. LOCAL REPORT NO.

71. WACOM

72. ACCIDENT TYPE (Check choice)

<input type="checkbox"/> a. Army Motor Vehicle	<input type="checkbox"/> n. Other Army Vehicle	<input type="checkbox"/> 10. Personal Injury - Other
<input type="checkbox"/> b. Army Combat Vehicle	<input type="checkbox"/> o. Fire	<input type="checkbox"/> 11. Property Damage - Other
<input type="checkbox"/> c. Army Operated Vehicle	<input type="checkbox"/> p. Chemical Agent	<input type="checkbox"/> 12. POV - On Official Business
<input type="checkbox"/> d. POV - Not on Official Business	<input type="checkbox"/> q. Explosive	<input type="checkbox"/> 13. Space
<input type="checkbox"/> e. Marine Driving	<input type="checkbox"/> r. Missile	<input type="checkbox"/> 14. Commercial Carrier/Transportation
<input type="checkbox"/> f. Marine Underway	<input type="checkbox"/> s. Radiation	
<input type="checkbox"/> g. Marine Not Underway	<input type="checkbox"/> t. Nuclear	

73. NAME OF SAFETY POINT OF CONTACT (POC)

74. PHONE NO. OF SAFETY OFFICE POC  
(AUTOVON Commercial, etc.)

75. DATE REPORT COMPLETED BY  
SAFETY OFFICE (YY/MM/DD)

## SECTION H - SPECIAL INTEREST AND/OR SUPPLEMENTAL INFORMATION

76

77

78

14.5     **ATTACHMENT: TVA Safety Program - Management Practice/Serious  
Accident Investigation**



LOCATION  
TENNESSEE VALLEY AUTHORITY

TITLE  
TVA SAFETY PROGRAM - MANAGEMENT PRACTICE/  
SERIOUS ACCIDENT INVESTIGATION

PROCEDURE NUMBER  
TVA/DASHO/STD/ALL/x.x

REV. 0

ISSUE  
XX/XX/XX

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USERS: ALL EMPLOYEES

Approved by

Date

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LOCATION  
TENNESSEE VALLEY AUTHORITY

PROCEDURE NUMBER  
TVA/DASHO/STD/ALL/x.x

TITLE

REV. 0

TVA SAFETY PROGRAM - MANAGEMENT PRACTICE/  
SERIOUS ACCIDENT INVESTIGATION

ISSUE  
XX/XX/XX

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## 1.0 PROCESS DESCRIPTION

This practice defines the process for investigating serious accidents in TVA including initial accident notification, assignment of an investigation team, conduct of investigation, reporting, communication of findings and recommended solutions, and follow-up activities.

## 2.0 OBJECTIVE

The objective is to ensure that a thorough investigation is conducted by establishing the facts related to the accident, determining the factors that caused or contributed to the accident, and determining the actions to prevent a recurrence. The objective is not to place blame on individuals or organizations but rather to identify why failures occur and to ensure appropriate corrective actions.

## 3.0 EVALUATION CRITERIA

- 3.1 The Designated Agency Safety and Health Official (DASHO) shall review each serious accident investigation to ensure that all steps in the process are completed, the investigation adequately identifies contributing factors/causes, and recommended solutions are implemented to prevent a recurrence.

## 4.0 REFERENCES

- 4.1 Title 29, Code of Federal Regulations, Part 1960, "Basic Program Elements for Federal Employee Occupational Safety and Health Programs and Related Matters," (defines "serious accidents" and establishes reporting requirements for accidents defined as serious).
- 4.2 TVA Safety Program - Management Practice/Reporting and Investigating Injuries/Illnesses.



LOCATION  
TENNESSEE VALLEY AUTHORITY

TITLE

TVA SAFETY PROGRAM - MANAGEMENT PRACTICE/  
SERIOUS ACCIDENT INVESTIGATION

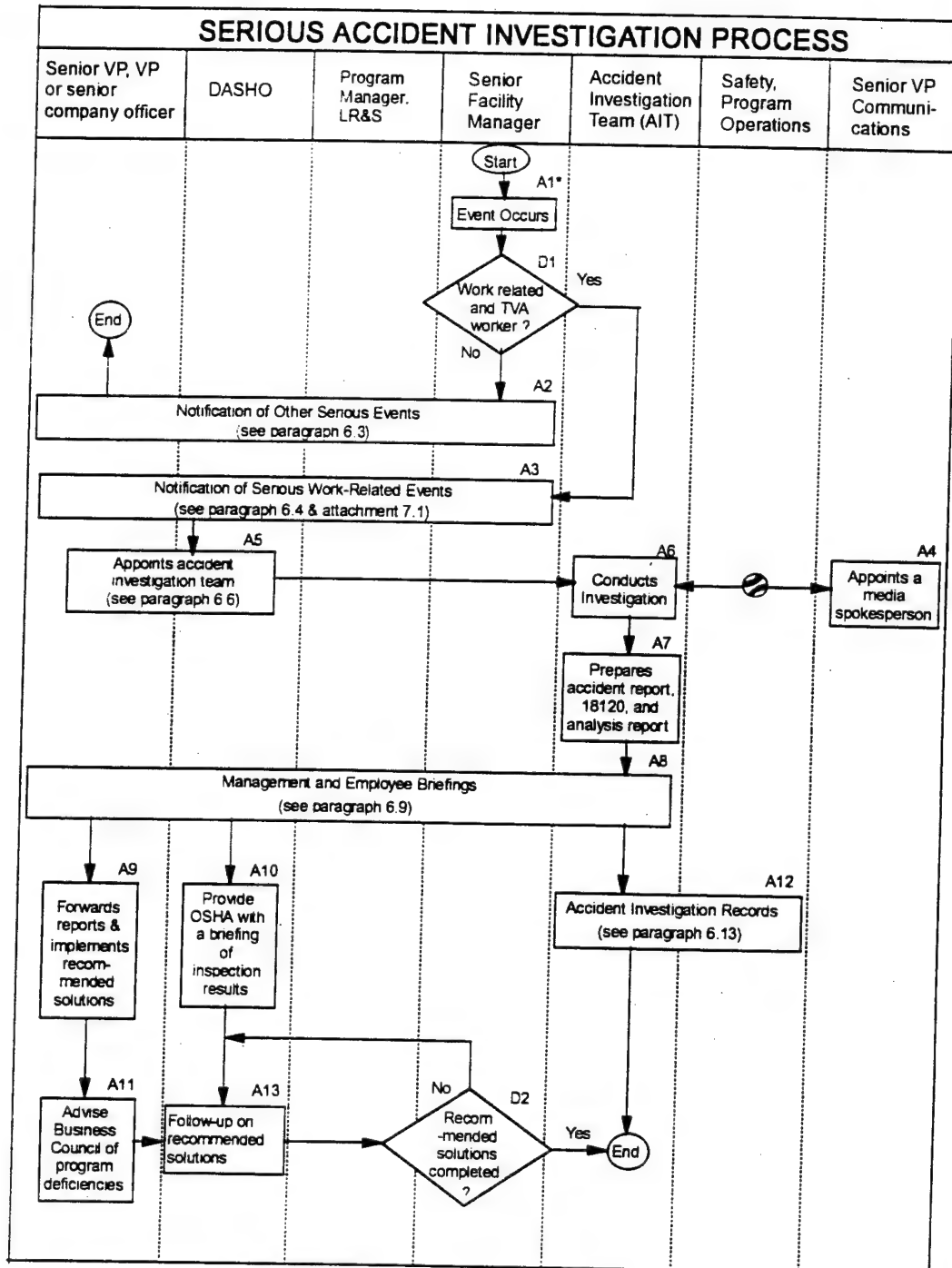
PROCEDURE NUMBER  
TVA/DASHO/STD/ALL/x.x

REV. 0

ISSUE  
xxx/xxx/xxx

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## 5.0 FLOWCHART



\* Alpha-numeric designations provide a means of referencing portions of the flow chart in the text to follow.



LOCATION  
TENNESSEE VALLEY AUTHORITY

PROCEDURE NUMBER  
TVA/DASHO/STD/ALL/x.x

TITLE

REV. 0

TVA SAFETY PROGRAM - MANAGEMENT PRACTICE/  
SERIOUS ACCIDENT INVESTIGATION

ISSUE  
xx/xx/xx

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## 6.0 PROCEDURE

### 6.1 Event (Activity Box A1)

This practice applies to all serious accidents that result in any of the following occurrences. EXCEPTION--Radiological control and nuclear operational safety incidents subject to other specific reporting and investigation requirements are investigated by TVA Nuclear (TVAN) as required by applicable procedures.

#### 6.1.1 Serious Work-Related Events

6.1.1.1 A fatality or in-patient hospitalization of three or more TVA employees within 30 days of an accident.

6.1.1.2 Accidental damage to TVA property with an estimated value of \$250,000 or more excluding operating losses.

6.1.1.3 Any event which under slightly different circumstances would have met the criteria in 6.1.1.1 or 6.1.1.2 or may meet these criteria in time. An accident will be defined as serious under this provision upon agreement by the DASHO and the senior vice president, vice president, or senior company officer.

6.1.2 Other Serious Events (require notification but not investigation in accordance with this procedure)

6.1.2.1 TVA employee fatality occurring during nonwork status.

6.1.2.2 Serious accident involving contractor employees.

6.1.2.3 Fatalities to members of the public on TVA property.

### 6.2 Decision Diamond D1

For serious work-related events go to paragraph 6.4. For other serious events go to paragraph 6.3.

### 6.3 Notification of Other Serious Events (Activity Box A2)

Other serious events as defined under paragraph 6.1.2 shall be immediately reported by the senior site manager to the appropriate senior vice president, vice president, or senior company officer and the Program Manager, Labor Relations and Safety (LR&S) (see attachment 7.1 for telephone numbers). The senior vice president, vice president, or senior company officer will ensure that the Board; appropriate company officer; and Senior Vice President, Communications, are



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notified. However, these events are not required to be investigated in accordance with this procedure.

**6.4 Notification of Serious Work-Related Events (Activity Box A3)**

6.4.1 The senior manager at the site of the accident shall:

6.4.1.1 Immediately notify the senior vice president, vice president, or senior company officer and the Program Manager, LR&S, as required in attachment 7.1. The notification shall include the accident location, time of the accident, name(s) of the individual(s) involved, the extent of the injuries, the name and telephone number of a contact person, and a brief description of the occurrence. The Program Manager, LR&S, must be notified as soon as possible so TVA can comply with the OSHA eight-hour reporting requirement.

6.4.1.2 Secure the accident scene to prevent any disturbance of the evidence and to protect people and property from any hazards associated with the accident until the scene is released by the Accident Investigation Team (AIT) chairperson.

6.4.1.3 Identify all witnesses to the accident and obtain, where possible, preliminary witness statements. Witnesses should only be asked to state what happened in obtaining factual information concerning the accident. Other detailed questions will be asked by the AIT.

6.4.1.4 Photograph, if possible, the accident scene.

6.4.2 The senior vice president, vice president, or senior company officer will notify the TVA Board and the appropriate company officer (see attachment 7.1)

6.4.3 The Program Manager, LR&S, makes the notifications listed in attachment 7.1.

**6.5 Media Spokesperson (Activity Box A4)**

6.5.1 The Senior Vice President, Communications, will select a spokesperson to deal with the press and other members of the public during the accident investigation process. This person will serve as liaison between the AIT and the media for release of additional information.

6.5.2 The "Accident Report" (paragraph 6.8.2) may be released to the media after senior vice president, vice president, or senior company officer review and approval. After release of the report, the AIT chairperson will be available to the media to answer questions.



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## 6.6 AIT Appointment (Activity Box A5)

LR&S will maintain a list of several managers (PG10 level and above) from each line organization that are trained in accident investigation methodology. Managers on this list should also have a knowledge of quality improvement techniques.

### 6.6.2 Membership

The DASHO, in consultation with the senior vice president, vice president, or senior company officer of the organization where the serious accident occurred, will appoint an AIT to include:

- 6.6.2.1 One line manager from within the organization where the accident occurred other than the facility where the accident occurred. This manager will be selected as the chairperson. This manager will be on the list of trained managers discussed under 6.6.
  - 6.6.2.2 Two line managers from the facility where the accident occurred.
  - 6.6.2.3 The safety manager from the organization's central staff.
  - 6.6.2.4 Two line managers from organizations other than where the accident occurred. At least one of these managers will be selected from the list of trained managers discussed in 6.6.1.
  - 6.6.2.5 A representative for the DASHO. In addition to responsibilities as a team member, this individual provides advice relative to interpretation of this practice and provides expertise relative to accident investigation techniques. This team member will represent the DASHO during the investigation process.
- ### 6.6.3 Advisors
- 6.6.3.1 A representative from the General Counsel (GC). This individual provides advice and expertise on legal aspects of the investigation.
  - 6.6.3.2 If preliminary evidence indicates, the AIT chairperson may request assistance from the Inspector General's (IG) office.
  - 6.6.3.3 If preliminary evidence in a fire indicates arson, the AIT chairperson will request assistance from the TVA Police.
  - 6.6.3.4 Others with appropriate expertise as needed, such as engineers, fire protection engineers, etc. If the service of advisors are secured to assist in the investigation, they will perform tasks delegated by the chairperson. They will provide results of studies, tests,



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examinations, etc., to the chairperson and be prepared to answer questions by the AIT.

**6.7 Conduct of the Investigation (Activity Box A6)**

**6.7.1 The scope of the investigation will include:**

6.7.1.1 A complete determination and thorough analysis of the facts, circumstances, and conditions related to the accident.

6.7.1.2 The factors that caused or contributed to the accident.

6.7.1.3 An evaluation and determination of the actions necessary to ensure this accident (or similar type accident) does not recur.

**6.7.2 Investigation Methodology**

6.7.2.1 The AIT will report to the accident scene as soon as possible but in no case later than the day following the accident.

6.7.2.2 The AIT chairperson will brief team members on: (1) the purpose and scope of the investigation, formats, time constraints, etc., (2) background and preliminary details of the accident, (3) status of the accident scene (security, existing hazardous conditions, necessary precautions, personal protective equipment needed, operational needs for the investigation, etc.), and (4) arrangements for clerical and other administrative support.

6.7.2.3 The AIT will use analytical techniques, such as the TQM six-step problem solving methodology, Event Critique and Root Cause Analysis, Fault Tree Analysis, and Management Oversight and Risk Tree (MORT), in arriving at its opinions and recommended solutions. Whatever technique used should look at both programmatic and physical causes related to the accident. Specific additional instructions may be given to the AIT by the senior vice president, vice president, senior company officer, or the DASHO.

6.7.2.4 All evidence should be secured and maintained as part of the accident investigation file and classified as administratively confidential.

6.7.2.5 Interviews will be taped and later transcribed and/or a court reporter may be used. If there is any question about whether an injured employee can be interviewed, Health Services shall be consulted. All interviews are considered confidential by TVA.

**6.8 Reports (Activity Box A7)**

6.8.1 The Accident Report shall be completed by the AIT within five working days of the occurrence. This report contains only factual information



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and can be released for public information (see Attachment 7.2 for an example Accident Report cover and distribution).

6.8.2. The AIT is responsible for completing the form TVA 18120, Injury/illness Investigation Report, within six working days. If necessary, the 18120 will be revised to include causal information that was not available when the 18120 was first submitted to LR&S.

6.8.3 The "Accident Analysis Report" (2d report) shall be completed by the AIT within 30 working days of the occurrence. If 30 working days is not feasible, a time extension must be approved by the senior vice president, vice president, or senior company officer and the DASHO. This report will provide an in-depth analysis of the accident to identify all root causes and contributing factors. The analysis will consider all possible physical and programmatic causes. This report includes the final listing of opinions and recommended solutions. This report is administratively confidential (see Attachment 7.3 for an example Accident Analysis Report cover and distribution).

#### **6.9 Management and Employee Briefings (Activity Box A8)**

6.9.1 The AIT chairperson will provide copies of the accident analysis report to the senior vice president, vice president, or senior company officer; DASHO; and Manager, Safety. A briefing will be scheduled to present the results of the investigation. At the discretion of the senior vice president and DASHO, they may invite others as appropriate.

6.9.2 As soon as possible following the briefing in 6.9.1, the senior vice president, vice president, or senior company officer; DASHO; Manager, Safety; and the AIT chairperson will brief the affected senior company officer if not included in the briefing in 6.9.1.

6.9.3 As soon as possible following the briefing in 6.9.2, the senior vice president, vice president, or senior company officer; DASHO; and the AIT chairperson will brief the Executive Committee.

6.9.4 The senior vice president, vice president, or senior company officer will send copies of the final report to the Chief Operating Officer; Chief Administrative Officer; President, TVAN; the senior manager at the site where the accident occurred; the GC; Manager, Safety; and the DASHO. The DASHO will ensure that the agency health and safety committee is briefed on the accident at the next scheduled meeting.

6.9.5 The senior vice president, vice president, or senior company officer will ensure that managers and employees at the facility where the accident occurred are briefed on the investigation results within 60 working days of the occurrences. If investigation results are applicable to other TVA employees, additional briefings may be scheduled as necessary.



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**6.10 Share Information and Implement Recommended Solutions (Activity Box A9)**

6.10.1 The senior vice president, vice president, or senior company officer will assign responsibilities for implementing and following up on recommended solutions to ensure efficient and timely implementation. The senior vice president of all TVA organizations will review the recommended solutions and be responsible for replication of corrective actions as appropriate within their organization. The DASHO will be responsible for monitoring this effort.

6.10.2 The senior vice president, vice president, or senior company officer will ensure that preliminary findings and recommended solutions that might be applicable to other TVA facilities and work locations are promptly disseminated throughout the agency. The DASHO will provide assistance as needed and monitor related activities to ensure adequate sharing of information.

**6.11 OSHA Report (Activity Box A10)**

The DASHO shall provide OSHA, Office of Federal Agency Programs, with a briefing of the accident investigation. This briefing shall include: date/time of accident; agency/establishment name and location; accident consequences; a description of the operation, accident, causal factors; and agency corrective/preventive actions.

**6.12 Advise Business Council (Activity Box A11)**

The senior vice president, vice president, or senior company officer will advise the Business Council of agencywide implications or any program deficiencies identified by the investigation.

**6.13 Accident Investigation Records (Activity Box A12)**

6.13.1 After completing the investigation and briefing, the AIT chairperson will send all accident investigation materials to Safety, Program Operations, MPB 1B, Muscle Shoals, AL 35662-1010.

6.13.2 Safety, Program Operations, will retain all original AIT investigation documentation in TVA's serious accident repository file. Release of any part of the accident file will require DASHO authorization.

**6.14 Follow-up on Recommended Solutions (Activity Box A13, and Decision Diamond D2)**

The DASHO, as part of corporate oversight responsibility, will periodically follow-up on AIT recommended solutions until all are completed, as well as assess the effectiveness of this practice.



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7.0 ATTACHMENTS

7.1 Serious Accident Notification Contact List

7.2 Example, Accident Report Cover and Distribution

7.3 Example, Accident Analysis Report Cover and Distribution



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Attachment 7.1      **SERIOUS ACCIDENT NOTIFICATION CONTACT LIST**

Senior manager at the facility/site where the accident occurred contacts:

1. Senior vice president/vice president/or senior company officer
2. Program Manager, Labor Relations and Safety (Tommy Lucas)  
Office: 423/632-7753 (during business hours)  
Home: 423/524-3723 (after hours)  
Pager: 1-800-443-7243 (24 HOURS)
  - Wait for voice prompt and enter access code 032182
  - Wait for a beep - enter your area code and 7 digit phone numberAlternate: Manager, Safety (Gene Walters)  
Office: 423/632-7756  
Home: 423/922-3679

Senior vice president/vice president/or senior company officer contacts:

1. TVA Board: 423/632-2531
2. As appropriate, contact either:  
Chief Operating Officer: 423/632-3108 or 423/751-7572  
Chief Administrative Officer: 423/632-4765  
President, TVA Nuclear: 423/751-4470  
Chief Financial Officer: 423/632-3987

Program Manager, LR&S, contacts:

1. OSHA Area Office: 423/781-5423 or 1-800-321-OSHA
2. Designated Agency Safety and Health Official (DASHO): 423/632-7870
3. General Counsel: 423/632-7038
4. Inspector General: 423/632-4120
5. Employee Assistance Program: 432/751-2850
6. Assistant Administrator of the Tennessee Valley Trades and Labor (T&L) Council: 615/885-4323
7. Appropriate T&L Craft Representative
8. Chairperson, Salary Policy Panel: 423/751-8604
9. Teamsters Union: 706/861-2160
10. Senior Vice President, Communications: 423/632-8018



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Attachment 7.2 Example, Accident Report Cover and Distribution

June 8, 19XX

Senior Vice President, Vice President, or Senior Company Officer

ACCIDENT REPORT, FATAL INJURY TO JOHN DOE, JUNE 4, 19XX

Attached is the "Accident Report" concerning the fatality of John Doe, Building Maintenance. This report was prepared by an accident investigation team consisting of the following members.

Name	Job Title and Organization
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

(Name)

Accident Investigation Team Chairperson

Attachment

cc: Designated Agency Safety and Health Official  
General Counsel  
Inspector General (As appropriate)  
Senior Manager at Site Where Accident Occurred  
Chief Operating Officer  
Chief Administrative Officer  
President, TVA Nuclear  
Chief Financial Officer  
Senior Vice President, Communications  
Manager, Safety



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Attachment 7.3 Example, Accident Analysis Report Cover and Distribution

**ADMINISTRATIVELY CONFIDENTIAL**

## **ACCIDENT ANALYSIS REPORT**

**FATAL INJURY TO JOHN DOE**

**BUILDING MAINTENANCE**

**June 4, 19XX**

SUBMITTED BY:

\_\_\_\_\_  
R. A. King, NP  
Chairperson

\_\_\_\_\_  
Date

AIT MEMBERS:

1. C. J. Peoples, BM
2. J. J. Holland, BM
3. O. W. Lawson, NP

DISTRIBUTION:

TO: Senior Vice President, Vice President, or Senior Company Officer;  
Designated Agency Safety and Health Official; Manager, Safety; General Counsel;  
and Senior Manager at Site where Accident Occurred.

This report has been developed to allow improvements in TVA's safety program.  
This report will not be reproduced.

14.6

**ATTACHMENT: U.S. Department of Labor Form CA-1 (Nov. 89) - Federal Employee's  
Notice of Traumatic Injury and Claim for Continuation of Pay/Compensation**

Federal Employee's Notice of  
Traumatic Injury and Claim for  
Continuation of Pay/Compensation

U.S. Department of Labor  
Employment Standards Administration  
Office of Workers' Compensation Programs



Employee: Please complete all boxes 1 - 15 below. Do not complete shaded areas.

Witness: Complete bottom section 16.

Employing Agency (Supervisor or Compensation Specialist): Complete shaded boxes a, b, and c.

Employee Data

1. Name of employee (Last, First, Middle)

2. Social Security Number

3. Date of birth Mo. Day Yr.

4. Sex

☐ Male ☐ Female

5. Home telephone ( )

6. Grade as of date of injury Level Step

7. Employee's home mailing address (Include city, state, and zip code)

8. Dependents

- ☐ Wife, Husband  
☐ Children under 18 years  
☐ Other

Description of Injury

9. Place where injury occurred (e.g. 2nd floor, Main Post Office Bldg., 12th & Pine)

10. Date injury occurred Time  
Mo. Day Yr. : ☐ a.m. ☐ p.m.

11. Date of this notice  
Mo. Day Yr.

12. Employee's occupation

13. Cause of injury (Describe what happened and why)

14. Nature of injury (Identify both the injury and the part of body, e.g., fracture of left leg)

a. Occupation code

b. Type code

c. Source code

OWCP Use - NOI Code

Employee Signature

15. I certify, under penalty of law, that the injury described above was sustained in performance of duty as an employee of the United States Government and that it was not caused by my willful misconduct, intent to injure myself or another person, nor by my intoxication. I hereby claim medical treatment, if needed, and the following, as checked below, while disabled for work:

- ☐ b. Continuation of regular pay (CCP) not to exceed 45 days and compensation for wage loss if disability for work continues beyond 45 days. If my claim is denied, I understand that the continuation of my regular pay shall be charged to sick or annual leave, or be deemed an overpayment within the meaning of 5 USC 5584.  
☐ a. Sick and/or Annual Leave

Signature of employee or person acting on his/her behalf

Any person who knowingly makes any false statement, misrepresentation, concealment of fact or any other act of fraud to obtain compensation as provided by the FECA or who knowingly accepts compensation to which that person is not entitled is subject to civil or administrative remedies as well as felony criminal prosecution and may, under appropriate criminal provisions, be punished by a fine or imprisonment or both. Have your supervisor complete the receipt attached to this form and return it to you for your records.

End of Employee Report

Witness

16. Statement of witness (Describe what you saw, heard, or know about this injury)

Name of witness

Signature of witness

Date signed

Address

City

State

Zip Code

14.7 ATTACHMENT: TVA Form 9179 (4/88) - Claims of Disability for Work Due to job-  
Related Injury

**CLAIMS OF DISABILITY FOR WORK DUE TO JOB-RELATED INJURY:  
NOTICE OF EMPLOYEE'S RESPONSIBILITIES**

According to regulations of the Federal Employees' Compensation Act (FECA), as revised effective June 1, 1987, if you are claiming disability for work due to a job-related injury, you have certain obligations as listed below.

1. **FILE A CLAIM PROMPTLY** - Complete the employee's side of claim form OWCP CA-1 and submit it to your supervisor as soon as possible, but **NO LATER THAN THIRTY DAYS AFTER THE DATE OF INJURY**.
2. **SUBMIT MEDICAL EVIDENCE** - Submit to TVA within 10 workdays medical evidence of disability for work due to the claimed injury.
3. **INFORM YOUR DOCTOR OF TEMPORARY LIGHT DUTY** - Inform your doctor of any offer by TVA to provide temporary light duty, where possible, to accommodate medical constraints imposed by the claimed injury.
4. **INFORM YOUR DOCTOR OF ALTERNATE JOBS** - Inform your doctor of any particular alternate jobs made available by TVA, and furnish the doctor with any written description of the specific duties and physical requirements of such jobs furnished by TVA.
5. **INFORM TVA IMMEDIATELY OF ANY MEDICAL LIMITATIONS OR CONSTRAINTS SPECIFIED BY YOUR DOCTOR.**
6. **RETURN TO WORK** - You are obligated to return to regular duty as soon as you are able to do so. **ALSO**, you are obligated to accept suitable offers by TVA of temporary light duty or alternate jobs not in conflict with medical limitations caused by the claimed injury.
7. **REPORT ALL EMPLOYMENT AND SELF EMPLOYMENT ACTIVITIES** - For all periods in which you claim COP or Compensation you are required to report all employment and self employment activities. You must report the activities performed and the income earned. Earned income for employment activities is defined as actual salary, wage, sales commissions, piecework commissions, and other payments of value such as housing allowances, meals, food, clothing, equipment, reimbursed expenses, etc. Additionally, if you performed activities in connection with a relative's or spouse's business, you must report as earned income what it would have cost the employer or organization to hire someone to perform the work you performed. For self employment activities, earned income is defined as the gross income received from the activity, if the self employment activity was operated at a loss or if the profits were reinvested you must report what it would cost to hire someone to perform the work you performed.

According to the FECA, WHERE AN EMPLOYEE REFUSES SUITABLE WORK offered by the employing agency according to FECA regulations, ENTITLEMENT TO COP CEASES as of the effective date of availability of such work.

Where an employee FAILS TO SUBMIT THE REQUIRED MEDICAL EVIDENCE WITHIN 10 WORKDAYS or REFUSES SUITABLE WORK, COP SHALL BE TERMINATED.

I have been informed of and understand the employee's responsibilities listed above.

\_\_\_\_\_  
EMPLOYEE'S SIGNATURE                      DATE

\_\_\_\_\_  
OFFICIAL SUPERIOR'S SIGNATURE                      DATE

PENALTIES UNDER 20 CFR, SECTION 10.13 ARE SHOWN ON THE BACK OF THIS SHEET.

14.8     **ATTACHMENT: TVA Form 255 (1/90) - Report of Vehicle Accident, Theft, or Fire**  
**(TVA Vehicle Only)**

## REPORT OF VEHICLE ACCIDENT, THEFT, OR FIRE

## Instructions

Prepare report immediately after occurrence. For accident or fire involving TV-00001 through TV-99999 send 3 copies to Transportation Services, Chattanooga and for TV-50000 through TV-99999 send 3 copies to Heavy Equipment Department, Chattanooga. For theft send 2 copies to Transportation Services or Heavy Equipment Department as appropriate and third copy to nearest TVA Public Safety Office. Always send 1 copy to employee's supervisor. Supervisor completes Supplement (pages 3 and 4) and distributes all four pages according to the instructions at the bottom of page 4.

<b>TVA DRIVER</b>	Payroll Name	Age	Social Security Number	TVA Telephone
	Payroll Department	Group or Organization		
	Supervisor's Name	Title	TVA Address	TVA Telephone
	Responsible Manager	Title	TVA Address	TVA Telephone
<b>TIME AND LOCATION</b>	Date Occurred	Hour	Street or Road	City and State
<b>TVA VEHICLE</b>	Make	Model	Body Type	License Number
<b>DAMAGE TO VEHICLE</b>	Description of Damage			
	Estimated Amount			
<b>DISPOSITION OF TVA VEHICLE</b>	Still in Service			Left at TVA garage or other
<b>PROPERTY OF OTHERS</b>	Kind Of Property And extent Of Damage			
	Estimated Amount			
	Automobile	Make And Year	Body Type	License Number State
	Owner Of Property	Address		Telephone
Where Property Can Be Seen				
<b>OTHER DRIVER</b>	Other Car Driver's Name		Address	Occupation Telephone
	Insurance Carried By		Kind Of Insurance	
	Driver Owner None		Liability Collision Medical	
	Name Of Insurance Company			
<b>PASSENGERS</b>	Full Name	Age	Address	TVA NONTVA
<b>OTHER WITNESSES</b>	1. _____			
	2. _____			
	3. _____			
<b>PERSONS INJURED IN ACCIDENT</b>	1. _____			
	2. _____			
	3. _____			
	4. _____			
	Nature And extent Of Injuries			
Doctor's Name				
Place Injured Were				

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Vehicle		Speed (mph)	
Owned or Rented	Other Vehicle	When Danger First Noticed	At Impact
Restraints Devices		Seat Belt Installed Seat Belt Worn	Shoulder Belt Installed Shoulder Belt Worn
Highway Conditions		Backstop On grade	Concrete Level
Light		Daylight Night	Gravel-dirt Curve
Weather		Clear Rain	Dusk-dawn Snow
Traffic Citations		Offense Charged to You	Offense Charged to Other Driver
Investigating Officer		State	County

# SKETCH ACCIDENT ON DIAGRAM

- Write in street names or numbers
- Show traffic signs and control devices
- Show lanes, double yellow lines, center strips, etc.
- Show direction and distance to nearest town, major intersection, and landmarks
- Draw and number vehicles involved and parked

- Use solid line to show path before accident and broken line after accident.
- Show pedestrian
- Show railroad
- Show skid marks, and give lengths
- Attach any photos

Indicate North  
by arrow in circle



DESCRIPTION  
OF ACCIDENT  
THEFT OR  
FIRE  
Use  
additional  
sheets if  
necessary

PRIVACY ACT  
OF 1974

In compliance with the Privacy Act of 1974, the following information is provided. Collection of the information is authorized by the Tennessee Valley Act of 1933, 16 U.S.C. 831cc and 40 U.S.C. 431. Disclosure of information is required by TVA regulations (TVA INSTRUCTION II TRANSPORTATION, Equipment). An employee of a Federal agency who fails to report accurately a motor vehicle accident involving a Federal vehicle may be subject to administrative sanctions. The principal purposes for collecting this information are: (1) To provide necessary data for use by legal counsel in any actions resulting from the accident; and (2) To provide accident information and statistics for use in analyzing accident causes and developing methods of reducing accidents. Routine uses include disclosure to Federal, State, and local governments and agencies when relevant to their criminal, administrative, and regulatory investigations, actions, and proceedings.

DATE

**SUPPLEMENT**  
**ADMINISTRATIVELY CONFIDENTIAL WHEN COMPLETED**  
**CONFIDENTIAL OPINION(S) AND RECOMMENDED ACTION(S) TO**  
**PREVENT RECURRENCE OF**  
**VEHICLE ACCIDENT, THEFT, OR FIRE**

**SUPERVISOR'S REVIEW, OPINIONS, AND RECOMMENDATION(S)**

Supervisor completes this supplement and distributes according to instructions on page four

Reviewer's Name \_\_\_\_\_ Date \_\_\_\_\_ Date of Accident \_\_\_\_\_

What was happening before the accident?

- ☐ 01 Roadway driving  
☐ 02 Off-the-road driving

- ☐ 03 Vehicle being serviced  
☐ 04 Vehicle idle

What type of vehicle?

- ☐ 001 Passenger car/van/wagon  
☐ 003 Compact car  
☐ 005 Tractor-truck  
☐ 007 Other type vehicle (specify) \_\_\_\_\_

- ☐ 002 Pickup truck  
☐ 004 Compact pickup truck  
☐ 006 Other truck

Accidents involving damage to other types of vehicles such as industrial forklifts, mowers, scooters, construction equipment not being used as a motor vehicle at the time of the accident, etc. should be reported on form TVA 18002 Report of Accidental Property Damage, Fire, or Fire Related Incident.

An accident is Driver-Controllable if in your opinion the TVA driver could likely have prevented the accident through prudent actions. In your opinion was this accident Driver-Controllable? ☐ Yes ☐ No

Why? \_\_\_\_\_

What immediate actions do you recommend be taken to prevent recurrence of a similar accident?

	Recommended Action	Person Responsible	Completion Date
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

What long-term actions do you recommend be taken to prevent a recurrence of a similar accident?

	Recommended Action	Person Responsible	Completion Date
1	_____	_____	_____
2	_____	_____	_____
3	_____	_____	_____
4	_____	_____	_____

Reviewer signature \_\_\_\_\_

Next higher level management signature \_\_\_\_\_  
 Approval of Recommended action(s) \_\_\_\_\_

Date \_\_\_\_\_

Use for continuation of narrative or other information which in your opinion is of importance.

**Distribution** Send copies of all four pages to:  
OC H&S, WPB 1E 207B-M  
TVA General Counsel, Knoxville  
Transportation Services, Chattanooga TN 37601 TN 99999  
Appropriate Heavy Equipment Department TN 37600 TN 99999  
Appropriate Responsible Manager

14.9

**ATTACHMENT: Form SR-13 (1/93) Alabama Department of Public Safety Accident  
Involving a Private Vehicle**

SR-13

Revised 1/93)

Alabama Department of

Public Safety

Driver License Division  
Safety Responsibility Unit

P.O. Box 1471

Montgomery, AL 36102-1471

For Office Use Only

DOC No.

Case No.

COMPLETION OF THIS FORM IS REQUIRED BY §32-7-1, CODE OF ALABAMA 1975.

FAILURE TO FILE A REPORTABLE ACCIDENT ON THIS FORM MAY RESULT IN SUSPENSION OF YOUR DRIVER LICENSE.

**INFORMATION AND INSTRUCTIONS:** Completion of this form is required ONLY if a motor vehicle accident occurring in Alabama caused death, personal injury, or property damage to any one owner in excess of \$250. The driver of any motor vehicle, which is in ANY MANNER involved in an accident in this state, is legally required to file a report on this form with the Department of Public Safety within ten (10) days after the accident regardless of whether or not at fault and regardless of whether or not the vehicle involved was covered by liability insurance at the time of the accident. If such driver is physically incapable of making such report, the owner of the motor vehicle involved in such accident shall, within ten (10) days after learning of the accident, make such report.

DATE OF ACCIDENT	<input type="checkbox"/> A.M. <input type="checkbox"/> P.M.	NO. OF VEHICLES	For Office Use Only		
LOCATION OF ACCIDENT (ST./HIGHWAY)		COUNTY	Subject	Injuries	Claims

## VEHICLES INVOLVED

YOUR INFORMATION (PLEASE PRINT OR TYPE)				OTHER PARTY'S INFORMATION (PLEASE PRINT OR TYPE)			
YOU ARE THE: <input type="checkbox"/> DRIVER <input type="checkbox"/> PEDESTRIAN <input type="checkbox"/> PROPERTY OWNER <input type="checkbox"/> OTHER				OTHER PARTY WAS: <input type="checkbox"/> DRIVER <input type="checkbox"/> PEDESTRIAN <input type="checkbox"/> PROPERTY OWNER <input type="checkbox"/> OTHER			
NAME (FIRST, MIDDLE, LAST)		TELEPHONE NO.		NAME (FIRST, MIDDLE, LAST)		TELEPHONE NO.	
ADDRESS: STREET NO.				ADDRESS: STREET NO.			
CITY		STATE	ZIP	CITY		STATE	ZIP
DRIVER'S DATE OF BIRTH		SEX <input type="checkbox"/> M <input type="checkbox"/> F	DRIVER LICENSE NO.	DRIVER'S DATE OF BIRTH		SEX <input type="checkbox"/> M <input type="checkbox"/> F	DRIVER LICENSE NO.
NAME OF OWNER		IF SAME AS DRIVER, MARK BOX <input type="checkbox"/>		NAME OF OWNER		IF SAME AS DRIVER, MARK BOX <input type="checkbox"/>	
ADDRESS OF OWNER: STREET NO.				ADDRESS OF OWNER: STREET NO.			
CITY		STATE	ZIP	CITY		STATE	ZIP
OWNER'S BIRTH DATE		SEX <input type="checkbox"/> M <input type="checkbox"/> F	OWNER'S DRIVER LICENSE NO.	OWNER'S BIRTH DATE		SEX <input type="checkbox"/> M <input type="checkbox"/> F	OWNER'S DRIVER LICENSE NO.
YOUR VEHICLE				OTHER VEHICLE (Use additional form if more than two (2) vehicles)			
YEAR	MAKE	TYPE	COMMERCIAL VEHICLE <input type="checkbox"/> YES <input type="checkbox"/> NO	YEAR	MAKE	MODEL	TYPE
VIN		LICENSE PLATE NO.		VIN		LICENSE PLATE NO.	

## PROPERTY DAMAGE

DESCRIPTION OF PROPERTY DAMAGE (OTHER THAN VEHICLE)

## INJURED PERSONS (CLAIM FOR PERSONAL INJURY ON REVERSE)

FULL NAME OF INJURED IN YOUR VEHICLE	DO INJURED <input type="checkbox"/> YES <input type="checkbox"/> NO
ADDRESS: STREET NO.	
CITY	STATE ZIP
DATE OF BIRTH   SEX <input type="checkbox"/> M <input type="checkbox"/> F   INJURED WAS (Please circle):	
<input type="checkbox"/> DRIVER <input type="checkbox"/> PASSENGER <input type="checkbox"/> PEDESTRIAN <input type="checkbox"/> OTHER	
NAME OF INJURED IN YOUR VEHICLE	DO INJURED <input type="checkbox"/> YES <input type="checkbox"/> NO
ADDRESS: STREET NO.	
CITY	STATE ZIP
DATE OF BIRTH   SEX <input type="checkbox"/> M <input type="checkbox"/> F   INJURED WAS (Please circle):	
<input type="checkbox"/> DRIVER <input type="checkbox"/> PASSENGER <input type="checkbox"/> PEDESTRIAN <input type="checkbox"/> OTHER	

## INSURANCE AND/OR SECURITY

Complete the following as required by the Safety Responsibility Law of Alabama (§32-7-1 and following sections). Mark only the appropriate box. All information will be verified.

- ☐ 1. No liability insurance in effect at time of accident.
- ☐ 2. Form SR-23 (fleet policy) on file with DPS.
- ☐ 3. Your vehicle is a qualified carrier with APSC. ☐ YES ☐ NO
- ☐ 4. Department of Public Safety Self-Insurance Certificate No. \_\_\_\_\_
- ☐ 5. Motor vehicle liability policy issued by \_\_\_\_\_

(Name of insurance company, not agency)

POLICY NO. \_\_\_\_\_

POLICY PERIOD FROM \_\_\_\_\_ TO \_\_\_\_\_

14.10 **ATTACHMENT: Record of Signatures**

**Notice: All TVA personnel signing the attached document certify they, the undersigned, have read this Health and Safety Plan, understand its contents, and will comply with all provisions contained herein.**

